LOW-LEVEL WASTE DISPOSAL FACILITY FEDERAL REVIEW GROUP MANUAL

REVISION 1

NOVEMBER 1999

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Concurrence

The *Low-Level Waste Disposal Facility Federal Review Group Manual*, Revision 1, is approved for use as of the date of signature below by the Co-Chairs.

Date_____

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William E. Murphie	Jay Rhoderick
Co-Chair	Co-Chair

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TABLE OF CONTENTS

Section **Page**

List of Acronyms and Initialisms

ALARA	As Low As Reasonably Achievable
CA	Composite Analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOE O	U.S. Department of Energy Order
DOE M	U.S. Department of Energy Manual
DQO	Data Quality Objectives
D&D	Decontamination and Decommissioning
EM	Office of Environmental Management
EM-30	Deputy Assistant Secretary for Waste Management
EM-40	Deputy Assistant Secretary for Environmental Restoration
ER	Office of Environmental Restoration
FUSRAP	Formerly Utilized Sites Remedial Action Program
LFRG	Low-Level Waste Disposal Facility Federal Review Group
LLW	Low-Level Radioactive Waste
NRC	U.S. Nuclear Regulatory Commission
ORR	Operational Readiness Review
OSHA	Occupational Safety and Health Act
QA	Quality Assurance
PA	Performance Assessment
ROD	Record of Decision
SAR	Safety Analysis Report
WAC	Waste Acceptance Criteria
WM	Office of Waste Management

1. INTRODUCTION

The Department of Energy (DOE) is responsible for designing, constructing, operating, and closing low-level waste (LLW) disposal facilities in a manner that is protective of workers, the public, and the environment. In order to provide reasonable assurances that disposal of LLW will provide this protection in the long term, disposal facility operators prepare two types of radiological assessments. Namely, Performance Assessments (PAs) and Composite Analyses (CAs).

Required by DOE Order 435.1, these documents help establish design features and operating constraints that promote compliance with the Order's performance objectives and related performance measures. PAs are analyses of LLW disposal facilities performed to demonstrate that there is a reasonable expectation that the long-term performance objectives for a disposal facility will be satisfied. CAs are used as a planning tool to analyze the potential offsite impact of a low-level waste disposal facility in combination with other radioactive source terms that are expected to remain at the site. The Department has the responsibility for reviewing and approving these radiological assessments. The review and approval function is performed by DOE Headquarters.

Following approval of the PA and CA for a disposal facility, a Disposal Authorization Statement is prepared for approval by DOE Headquarters. The process for development of this key document and its content is also described in this manual.

1.1 Low-Level Waste Disposal Facility Federal Review Group

On June 27, 1997, the Deputy Assistant Secretaries for Waste Management and Environmental Restoration in the Office of Environmental Management (EM) established the Low-Level Waste Disposal Facility Federal Review Group (LFRG) to develop and implement a review process for LLW disposal facility PAs and CAs. The LFRG was chartered with providing management with the necessary information to determine if low-level waste disposal facilities are designed, constructed, operated, maintained, and closed in a manner that protects the public and environment. The approved charter appears in Appendix A.

DOE management officials are responsible for the approval of PAs and CAs in accordance with DOE Order 435.1. The establishment of the LFRG assigned the responsibility to Federal employees for reviewing PAs and CAs, determining compliance with performance objectives and measures, and recommending the approval of PAs and CAs. Establishing the LFRG also centralized the LLW disposal facility PA and CA review process to fulfill the Department's regulatory oversight process.

The LFRG consists of Federal employees from Headquarters and field organizations. Members are selected to ensure the LFRG reflects the policy, technical, regulatory, and programmatic perspectives necessary to conduct effective PA and CA reviews.

1.2 Purpose and Organization of this Manual

This manual provides guidance for conducting reviews of DOE LLW disposal facilities' PAs and CAs in accordance with DOE Order 435.1. Reviews shall be performed in accordance with these

procedures and guidance. The LFRG is responsible for conducting the reviews for DOE LLW disposal facilities of different designs and with varying potential for impacting public safety and health, and the environment. The guidance provided by this manual is intended to provide consistency in the conduct of and products from the review process. Review procedures and document formats may be modified, as appropriate, to address specific site conditions. Modifications to the procedures and formats contained in the guidance manual should be documented in the site-specific PA and/or CA review plans described in Chapter 2.

This manual is also intended to aid DOE program offices, DOE field offices, and the site contractors in understanding and preparing for the review of their PAs and CAs, as well as participating in the PA and CA review processes. The manual also serves as a means of informing other interested agencies and parties of DOE's processes for reviewing PAs and CAs.

The approved PA and CA for a facility are key documents that support the granting of a Disposal Authorization Statement for a disposal facility. This LFRG manual also provides guidance on the preparation and approval of Disposal Authorization Statements.

Reviewers who use this manual should report any feedback on or suggestions for improvement for the PA/CA review process to the LFRG. Reviewers and personnel at the site being reviewed should be encouraged by the LFRG and the reviewers to provide this feedback. The LFRG should consider these critiques and develop updates to this *LLW Federal Review Group Manual* as appropriate.

1.3 Purpose of PAs and CAs

PAs are conducted to demonstrate that there is a reasonable expectation that LLW disposed at DOE LLW facilities will not exceed the performance objectives contained in DOE Manual 435.1, *Radioactive Waste Management,* and related measures associated with protection of the public from the management of LLW. The three performance objectives imposed by DOE Manual 435.1 are:

(1) Dose to representative members of the public shall not exceed 25 mrem (0.25 mSv) in a year total effective dose equivalent from all exposure pathways, excluding the dose from radon and its progeny in air.

(2) Dose to representative members of the public via the air pathway shall not exceed 10 mrem (0.10 mSv) in a year total effective dose equivalent, excluding the dose from radon and its progeny.

(3) Release of radon shall be less than an average flux of 20 $pCi/m^2/s$ (0.74 $Bq/m^2/s$) at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/ℓ (0.0185 Bq/ℓ) of air may be applied at the boundary of the facility.

CAs are conducted to assess possible impacts of multiple sources, including the disposal facility, on long-term compliance with DOE environmental and public radiation protection requirements contained in DOE Order 5400.5, *Radiation Protection of the Public and the Environment.* The purpose of the analysis is to facilitate planning and land use decision that help assure that the

authorization of the disposal facility will not result in long-term compliance problems, and should potential problems be identified, to determine management alternatives and corrective actions or assessment needs. The CA is not a document which is prepared for the purpose of demonstrating compliance with DOE's primary dose limit for protection of the public. *The analysis is a planning tool intended to provide a reasonable expectation that current LLW disposal activities will not result in the need for future corrective or remedial actions to protect the public and environment.*

1.4 Purpose of PA and CA Review

The goal of the review process is to promote complete and comprehensive documents, which reflect the site- and facility-specific conditions, supported by appropriate rationale, and are therefore, defensible. The reviews are performed to provide management with the reasonable assurance that the applicable performance objectives and measures will be met. The reviews provide the basis for accepting the PA and/or CA, and for issuing Disposal Authorization Statements. The Disposal Authorization Statement represents Headquarters approval of the PA and/or CA, and includes conditions deemed necessary to provide long-term protection of the public and environment from the LLW disposal facility.

1.5 Purpose of the Disposal Authorization Statement

The Disposal Authorization Statement is the ultimate document verifying that the required radiological assessments have been performed and that they support the conclusions that there is a reasonable expectation that the low-level waste disposal performance objectives will be satisfied. It also documents limits on design, construction, operations and closure for the subject disposal facility. Approval of a Disposal Authorization Statement is also based on review of three additional facility-specific maintenance plan documents: (1) the performance assessment and composite analysis; (2) the preliminary closure plan; and (3) the preliminary monitoring plan.

1.6 Scope of the PA and CA Reviews

PA and CA reviews will be conducted for the LLW disposal facilities identified in the DOE's *Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 94-2* and any future LLW disposal facilities. The Implementation Plan, as modified, establishes a schedule for completion and approval of the PAs and CAs for the following LLW disposal facilities:

- Los Alamos National Laboratory, TA-54, Area G Disposal Facility;
- Idaho National Engineering and Environmental Laboratory Radioactive Waste Management Complex;
- Nevada Test Site Area 3 and Area 5 Radioactive Waste Management Sites;
- Oak Ridge National Laboratory Solid Waste Storage Area-6;

- Hanford Environmental Restoration Disposal Facility, 200-W Burial Grounds, 200-E Burial Grounds, and Immobilized Low-Activity Tank Waste; and

- Savannah River E-Area Vaults and Saltstone Disposal Facility.

Each PA and/or CA review will be a focused, site-specific review of the technical, regulatory, and programmatic adequacy. The complex-wide representation of Federal staff enhances DOE's LLW line management capabilities by providing a mechanism for transferring lessons learned from site to site.

1.7 PA/CA Review Process

LFRG Review Teams are convened to conduct reviews in a manner conceptually similar to DOE's processes for review of Safety Analysis Reports and for conducting Operational Readiness Reviews. The PA and CA Review Teams are comprised of federal employees. Teams may be supplemented with qualified consulting contractors as appropriate (i.e., to provide technical assistance, or expertise not readily available in DOE) that are approved by the LFRG.

The principal activities and products comprising a PA and CA review are:

- Acknowledge suitability of PA/CA for review;

- Assemble a PA/CA Review Team;

- Develop a PA/CA Review Plan;

- Conduct site visits and meetings;

- Review LLW disposal facility PA and CA;

- Compile a PA/CA Review Report; and

- Develop a Compliance Evaluation.

Figure 1-1 shows the major activities comprising the PA and CA review process. The PA and CA review process begins with a determination by the LFRG that the PA or CA is complete and suitable for review. If this determination is affirmative, the LFRG selects a PA and/or CA Review Team Leader. The Review Team Leader, after a concise review of the PA and/or CA, recommends candidate team members and areas of responsibility for the review to the LFRG for approval. Following team selection, the Review Team prepares a Review Plan for conducting the specific PA and/or CA review for which it has been formed.

The PA/CA Review Team should conduct the technical review of the PA and/or CA by evaluating the PA and/or CA against the criteria contained in Chapter 3 of this manual. The review includes a site visit and review of other site documentation, if necessary. The Review Team prepares a

Review Report and recommends to the LFRG that the PA and/or CA be accepted, accepted with conditions, or not accepted.

The LFRG prepares a Compliance Evaluation which either accepts the Review Team's recommendation or provides justification which supports the Team's recommendations. Management will consider the LFRG Compliance Evaluation during the review and approval of the Disposal Authorization Statement, which is prepared by the LFRG.

The elapsed time from conducting PA and/or CA reviews, through issuing final PA and/or CA Review Reports ranges from four to seven months. The duration of the review is affected by the lines of inquiry pursued by the Review Team. During the course of the review, additional information may be requested from the PA or CA preparers to support the assessment and its conclusions. The LFRG may continue involvement with other activities associated with preparation of the Compliance Evaluation and the Disposal Authorization Statement including maintenance updates by the sites, and records maintenance.

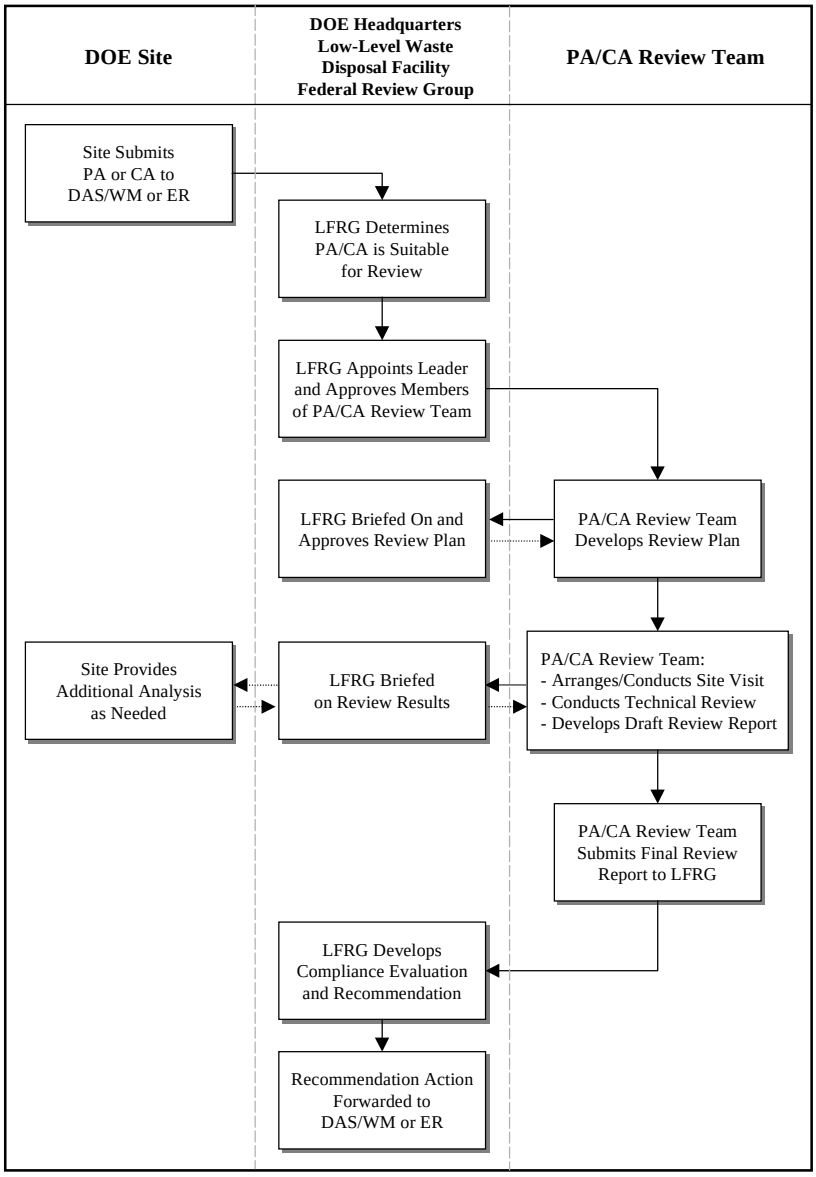

Figure 1-1: Major Activities Conducted During PA/CA Review

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2. PA/CA REVIEW PROCESS

This Chapter describes the administrative process and the basic technical framework under which the LFRG administers the reviews of radiological assessments (PAs and CAs) and formulates conclusions. Key planning steps, basic duties, and responsible individuals are identified. The administrative procedures, the basic technical framework, and the examples provided in the Appendices, will help ensure consistency among Review Teams in conducting and documenting the reviews of radiological assessments.

2.1 Establishing Suitability for Review

Upon receipt of a radiological assessment, the LFRG evaluates the document to determine if it is suitable for review. This evaluation determines if sufficient information is present for the Review Team to conduct an effective technical review. To expedite the review process, this initial evaluation can take place concurrently with the establishment of the Review Team.

2.2 Establishing a Review Team

The LFRG begins the establishment of a Review Team by selecting a Review Team Leader. Potential Team Leaders may come from a list of technically qualified DOE personnel maintained by the LFRG or may be a DOE employee nominated by a member of the LFRG. In selecting a Review Team Leader, the LFRG considers the type of review (i.e., PA only, or CA only, or both), the site- or facility-specific conditions and characteristics, and the capabilities of the candidates. The Team Leader performs a concise review of the radiological assessment and the list of candidates for Review Team members. The Team Leader proposes the Review Team members to the LFRG and any contractor technical specialists or consultants that he/she anticipates using in the review and they are selected with the concurrence of the LFRG Co-Chairs.

2.2.1 Team Membership

Review Team members are Federal personnel and contractor specialists selected for their technical qualifications and their knowledge and experience related to radiological assessment reviews; their knowledge of the important technical and regulatory disciplines underpinning the specific PA and/or CA to be reviewed; their technical and programmatic review experience; their demonstrated technical and managerial leadership skills; and their communication skills. At least one member of each team shall be an LFRG member.

At least one staff member from the DOE field office with responsibility over the PA and/or CA being reviewed is to serve as a liaison to the Review Team to provide first hand knowledge of the site being evaluated. As a liaison, this person provides the necessary contacts to arrange site visits, provide documents if requested, and answer questions about the radiological assessment.

Generally, the areas of expertise to be represented on a Review Team include hydrology, geology, hydrogeology, health physics, radiological exposure analysis (e.g., pathways analysis, conceptual

modeling, computer code evaluation, dose effects), chemistry, civil engineering (e.g., concrete degradation, evaluations of disposal facility engineering features), and waste form stability.

2.2.2 Conflicts of Interest

Sensitivity to potential conflicts of interest must be considered when selecting personnel for specific radiological assessment Review Teams. Persons will not be asked to review their own work or work for which the independence of their judgment might be adversely influenced. In evaluating potential Review Team members, the Team Leader should consider:

- If the person has ever been employed, directly or indirectly (e.g., through subcontract) at the site under review? If yes, what is/was the timing and nature of that employment?

- Is the person involved in waste management at a facility or site that has a generator-disposer relationship with the site under review? What are the person's relevant responsibilities?

- If the person has been involved in development of any models that are used for performing PA or CA modeling? If yes, what models and are those models used in the radiological assessment under review?

- If the person was materially involved in the preparation of any part of the analysis under review (e.g., providing data, developing models, performing analyses, writing, reviewing)? If yes, what was the nature of the person's involvement?

Federal employee members of the Review Teams are reminded that they remain subject to the conflicts of interest statutes and regulations that apply to all Department employees. Members may be asked to sign a "Confidentiality and Conflict of Interest Certification" (see Appendix E).

2.3 Review Team Responsibilities

The responsibilities of each person supporting a Review Team are discussed in this section.

Team Leader

The Team Leader manages the Review Team and serves as the primary contact point between the LFRG and the site representatives. The Team Leader's principal responsibilities are to:

(1) Obtain commitment of time and travel funds, as necessary, from his/her manager to support the review effort. The office employing the Team Leader is asked to pay for the Team Leader's time and travel.

(2) Select and familiarize Review Team staff including identifying and recruiting qualified DOE personnel as members and contractors as supplemental technical consultants, as necessary to meet the objectives of the review, with the concurrence of the LFRG Co-Chairs.

(3) Identify and address any conflict of interest issues for Review Team members and technical consultants.

(4) Manage and provide guidance to the Review Team staff concerning the overall review process and methodology, documentation requirements, draft and final Review Reports, Review Team meetings, and schedules.

(5) Develop a Review Plan that describes site visits, review approach, review products, necessary documents, and review milestones and schedules.

(6) Coordinate and manage Review Team discussions, site visits, and meetings.

(7) Coordinate communications among the Team Leader, Review Team members and consultants, and the LFRG. Coordinate activities of Review Team members and consultants so the results of the review are integrated.

(8) Serve as the point of contact for information requests regarding Review Team activities and reports.

(9) Inform Review Team staff of any DOE Headquarters policy and/or program changes and other pertinent information that could affect the review process or schedule.

(10) Compile the Review Report. Ensure the Report is accurate, objective, and thorough. Ensure that sufficient copies of the final Review Reports are printed and delivered to the LFRG, appropriate DOE Offices, and others.

(11) Ensure, with assistance from the DOE liaison from the site under review, that all pertinent documentation is placed into the administrative record during the review. Maintain the administrative record and any other records and files associated with Review Team activities, and provide them to the LFRG with the Review Report.

(12) Ensure, with assistance from the DOE liaison from the site under review, that progress on completion of any follow-up commitments (e.g., review of a report required by a condition contained in a Disposal Authorization Statement), LFRG recommendations, or other planned actions are tracked and reported to the LFRG until completed.

If desired, the Review Team Leader may appoint another individual to act as a Review Team Coordinator and delegate responsibilities to the coordinator. If appointed, the coordinator reports directly to the Review Team Leader throughout the review.

Team Members

The Review Team members' responsibilities are to:

(1) Obtain commitment of time and travel funds, as necessary, from his/her manager to support the review effort to ensure continuity in Review Team membership. The office employing each Review Team member is asked to pay for the member's time and travel.

(2) Confirm the review assignments with the Team Leader.

(3) Evaluate the radiological assessment against the criteria applicable to his/her assignment and the scope of the review contained in Chapter 3 of this manual.

(4) Provide the results of the radiological assessment review to the Team Leader. Ensure that the results are accurately reflected in the Review Report.

(5) Review any follow-up documentation as requested by the Team Leader or the LFRG.

Team Consultants

The team consultants may be Review Team members or may serve as non-member resources and their responsibilities are to:

(1) Obtain commitment of time and travel funds, as necessary, from his/her manager or sponsor to support the review effort to ensure continuity in Review Team membership.

(2) Confirm the review assignments with the Team Leader.

(3) Evaluate the technical area(s) of the radiological assessment for technical adequacy consistent with his/her assignment and the scope of the review.

(4) Provide the results of the radiological assessment technical area review to the Team Leader.

(5) Review any follow-up documentation as requested by the Team Leader or the LFRG.

Interaction with Regulatory Agencies and Others

External regulatory agencies (e.g., state environmental protection agencies, or other interested parties), may express an interest in the review of a radiological assessment for a specific DOE site or LLW disposal facility. Recognizing the Department's commitment to open interactions with external entities, the LFRG, the Review Team Leader, and site management are responsible for determining the best means of establishing an effective interface. Options for interfacing with external entities include providing progress reports, both written and oral, and extending an opportunity to participate with the Review Team as an observer.

2.4 Review Administrative Process

The administrative process established to conduct a radiological assessment review will: coordinate the activities of the LFRG and a Review Team; facilitate the interactions of the Review Team and the site and facility being evaluated; and establish a complete record of the review. An example review plan is provided in Appendix B.

PA/CA Review Plan

Prior to the review, the Review Team prepares a Review Plan to coordinate the activities of the review process. Key elements of the Review Plan are:

- General review approach;
- Planned specific activities;
- Review schedule and milestones;
- Review Team leader, members, and technical specialists identification;
- Administrative record requirements;
- Supporting data and documents to be reviewed;
- EM Quality Assurance Program implementation plans;
- Orientation Plans for Review Team members;
- Modifications or additions to the standard review criteria; and
- Plans for health and safety protection of the Review Team.

Administrative Record

The Review Team Leader establishes an administrative record for documenting the review and the review's results. This administrative record is similar to a docket file that is established for licensing actions by the U.S. Nuclear Regulatory Commission (NRC). All records associated with the review, including the Review Plan, site visit interactions and results, correspondence, technical documents, meeting minutes, briefing packages, Review Team member qualifications, and conflict of interest avoidance information become part of the administrative record. The administrative record is subject to, and administered under, the Office of Environmental Management (EM) Quality Assurance Program protocols. If possible, the administrative record should contain the originals of all documents. If copies are used as official records, they must be clearly marked as copies.

The administrative record is assembled and maintained by the Review Team Leader during the review and is turned over to the LFRG when the Review Report is submitted.

Quality Assurance

Radiological assessment review activities are performed in conformance with the requirements of the EM Quality Assurance Program, as defined on the EM World Wide Web Server (http://www.em.doe.gov/em30/). [This Internet site has restricted access, therefore, the LFRG will ensure that Review Team Leaders are provided with access to the site, or the relevant instructions for following the EM Quality Assurance Program.] The implementing protocols for the EM Quality Assurance Program guide the development and maintenance of the administrative record.

2.5 Site Visit

All members and consultants of the Review Team will usually benefit frm a site visit. At a minimum, this visit should include an orientation of the site and facility evaluated, and the radiological assessment under review, a tour of the site and facility, and meetings with knowledgeable site and facility personnel to exchange information about the facility, PA and/or CA.

2.5.1 Pre-Site Visit Activities

Prior to an initial site visit, the Review Team performs a preliminary review of the radiological assessment. The preliminary review is intended to: 1) confirm that the document is complete and ready for a comprehensive review; 2) determine if the Review Team has the collective expertise to perform a comprehensive review; and 3) identify information in the radiological assessment that requires discussion during the site visit. The findings of this preliminary review may be used to determine whether additional technical expertise and/or information is needed.

The preliminary review may include a review of past studies, assessments, reports, sampling and monitoring data, and other pertinent documents the Review Team needs to gain an understanding of site operations and existing or potential problem areas. A key role of the DOE liaison from the site under review is to identify and review Federal, state, and local statutes or regulations that are relevant to the review, including any site-specific requirements or guidance documents relevant to the information in the radiological assessment.

2.5.2 Site Visit Preparation

In order to maximize the benefit of site visits, the Team Leader and members should be thoroughly prepared. Proper preparation should include but not be limited to:

(1) Coordination of Site Activities and Information Needs

The Team Leader should contact the appropriate field office and site representatives to determine specific dates and logistics for a site visit.

After the dates and logistics for a site visit have been finalized, the Team Leader will notify the LFRG Co-Chairs who will prepare a letter of introduction to the field office manager from the cognizant Deputy Assistant Secretary . The letter should provide the dates for the site visit, list the Team Leader, Review Team members and consultants, the Review Team Coordinator if one is appointed, and set forth the Review Team's intended on-site activities. A copy of the Review Plan should be provided with the letter.

The letter should outline expectations for the site visit (e.g., site tour, meetings with PA preparers) and should list documents, if any, identified by the Review Team based on its preliminary review that need to be available. The letter should also include a request for the field office to identify its representatives and communication information (phone and fax numbers, e-mail addresses).

(2) Security and Health and Safety Planning

As part of the preparation for the site visit and tour, the Team Leader should coordinate the information flow to ensure that security badges are ready for attendees and that any other security or clearance matters are handled prior to arrival at the site. The site personnel coordinating the visit should provide the necessary papers, documents, and site logistics required to accomplish these important steps when arranging a visit.

Also, as part of preparation for the review site visit, the Team Leader needs to ensure that necessary health and safety planning is performed. If the Review Team members are going to be walking in or around areas under which OSHA health and safety and/or other regulations apply, the Team Leader needs to ensure that the necessary training or training waivers and other paperwork have been arranged with site personnel.

(3) Agenda

The Team Leader, along with the site representative, develop a detailed agenda for the site visit. A list of topics to be covered and issues to be considered during the review is developed based on the preliminary review of the radiological assessment. The details of the agenda, with logistics and appropriate attendees, should be worked with the site and facility contacts, and finalized at least five days prior to the visit. The Team Leader should ensure that all parties attending the meetings receive the agenda in advance of the visit.

2.5.3 Site Visit Activities

In order to maximize the benefit of the site visit for all participants, the Review Team should consider accomplishing the following actions:

(1) Meetings

The site visit provides the opportunity for meetings of the Review Team in which they can share technical information gathered during the visit and to discuss remaining site visit

activities. Meetings with preparers of the radiological assessment and other cognizant site and facility personnel also provide opportunities for exchange of information relevant to the PA and CA review. To the extent possible, the need for these meetings is identified prior to the site visit, coordinated appropriately, and scheduled on the agenda.

(2) Closeout Briefing

The Team Leader provides a closeout briefing for the site personnel before the Review Team leaves the site. This briefing provides an opportunity for final questions and answers, and exchange of information. Also at this point, any need for further documentation, site tours, technical meetings, and information exchanges with technical personnel can be identified and discussed.

(3) Documentation of Site Visit

Following the visit, the Team Leader prepares a trip report documenting the activities and results. The trip report is placed in the administrative record. The report should include the final agenda, minutes of meetings, documentation of the trip, a list of documents reviewed during the visit, and any other information deemed important to preserve as part of the administrative record. This trip report should be an attachment or appendix to the Review Report.

2.6 PA/CA Technical Reviews

The principal purpose of the Review Team's activities is to perform detailed technical reviews of PAs and/or CAs. Based on the reviews, the LFRG will formulate conclusions on whether there is reasonable expectation that the public and the environment are being sufficiently protected from the activities performed at LLW disposal facilities, as demonstrated in the evaluations, and make decisions about operations at the facilities. These evaluations need to be thoroughly reviewed so that the decisions made based on them are justifiable.

The detailed technical review of a PA and CA is to: (1) identify whether required information is present; (2) determine if the information presented is correct and applicable; and (3) determine if the analysis supports the conclusions. To that end, the PA and CA are reviewed against criteria to determine whether they are adequate and acceptable.
Chapter 3 provides the basic framework and technical criteria for the reviews. Review Findings represent broad conclusions reached on the PA or CA. Detailed acceptance criteria are included to apply to specific topics and discussions in the PA and CA in order to support the Review Findings. Minimum information expected in either the PA or CA to support the analysis, is provided in the guidance.

Following the review, the Review Team members determine whether the conclusions reached in the PA and/or CA are acceptable and supportable. The Review Team documents its findings in a report (discussed in detail in Section 2.8).

2.7 Additional Technical Information

Additional questions may arise as the Review Team is developing conclusions on the PA and/or CA. The Team should solicit additional technical information requested in accordance with the acceptance criteria presented in Chapter 3. Additional information requested by the Review Team should be in the form of existing data or information. The Review Team Leader should solicit the assistance of the DOE field office liaison in obtaining additional information and analysis.

The Review Team should not solicit additional PA or CA evaluations (e.g., a complete PA calculation to determine the results of an alternative scenario). If this type of additional evaluation is required, it should only be requested by the LFRG as a condition of acceptance of the PA or CA based on the conclusions of the Review Team on the existing PA and/or CA evaluations.

Additional information needs, requests, and meetings are to be documented and become part of the administrative record.

2.8 Review Report(s)

Following the technical review, the Review Team prepares a review report. The report summarizes the findings, technical adequacy and completeness of the radiological assessment, the issues identified from the review and their resolution, and any issues that were not resolved. The Review Team should include as appendices, supplemental information and/or documentation deemed necessary to understanding the review. The Review Report should include all of the information from the review needed to provide the basis for the LFRG's Compliance Evaluation (see Section 2.9) of the radiological assessment.

The following guidance is provided in two parts. First, guidance is provided on the PA Review Report. Separate guidance is provided on the CA Review Report. If a Review Team has the opportunity to simultaneously review the PA and CA for a low-level waste disposal facility, then the two parts of the guidance could be combined to create one Review Report.

2.8.1 PA Review Report Outline

A suggested PA Review Report outline is as follows:

i Executive Summary
1.0 Introduction
2.0 Summary of Site and Facility Description
3.0 Summary of Performance Assessment Review
4.0 Technical Adequacy of Performance Assessment
5.0 Consistency of Performance Assessment
6.0 Unresolved Issues
7.0 Recommendation of Review Team

8.0 Appendices
- *A. Review Team Members and Consultants and Their Qualifications*
- *B. Review Plan*
- *C. Chronology of Review*
- *D. Comments from Review Team Members*
- *E. List of Important Communications Between Site and Review Team*
- *F. List of Supporting Documentation Utilized During the Review*

The following sections address these suggested elements of a PA Review Report.

2.8.2 PA Review Report Development

The conclusions of the PA review with respect to the criteria presented in Chapter 3 are to be addressed in a Review Report. This guidance is not intended to provide a comprehensive discussion applicable to all PAs. Instead, the Review Team should customize their report under the headings suggested in the outline and provide a concise reflection of the PA review conducted. The Review Report should include references to the PA and any related documentation. The conclusion of the Review Report should include a recommendation that the PA be *accepted*, *accepted with conditions*, or *not accepted*. The Review Report should be considered a final stand-alone document. Once submitted to the LFRG in final, no changes should be made to the Review Report.

1.0 Introduction

This section provides a brief introduction on the purpose of the report, and includes a citation of the PA being reviewed and the guidance used to conduct the review. There should also be a concise statement of the review process and Review Team findings, as well as an overview of the report format.

2.0 Summary of Site and Facility Description

This section provides a concise description of the LLW disposal facility that is the topic of the PA, including the surrounding site. The material in this section could be extracted from the PA and presented as background to any readers of the Review Report who are unfamiliar with the site and the disposal facility.

3.0 Summary of Performance Assessment Review

This section provides an overview of the PA review. Any documentation from the site that was prepared in response to requests from the Review Team should be briefly discussed. Issues identified during the course of the review and the resolution of those issues should be discussed in this section.

The conclusions of the review are presented in this section. References to any appendices for extended discussions contained in the minutes of the meetings of the Review Team are appropriate. References to appendices that identify the members and consultants on the Review Team, and the chronology of the review are also appropriate.

4.0 Technical Adequacy of Performance Assessment

This section provides discussion of the following aspects of the PA:

- The performance measures that were used and the basis as appropriate interpretations of the performance objectives; and
- A summary of the method of analysis and the calculated results.

This section also provides discussion of the following aspects of the review of the PA:

- The review findings that the assessment is complete, thorough and technically supported and that conclusions are valid and acceptable;
- Major issues relating to the technical adequacy of the PA; and
- The basis for concluding the PA is technically adequate and that there is a reasonable expectation that performance objectives of DOE Manual 435.1 will be met.

5.0 Consistency of Performance Assessment

This section documents the consistency of the PA and any additional material developed in the review with the *Interim Format and Content Guide and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments*. Discussion of how the guidance was interpreted for the PA, and a judgment on the consistency of approach taken with respect to: the PA guidance; existing laws; regulations; DOE Orders; DOE policy; and any applicable agreements with regulatory agencies or affected states. Conflicts with the PA guidance and other competing regulatory matters should be identified and the approach taken in the PA in addressing these conflicts identified. The significance of any inconsistencies with respect to the acceptance of the PA should be discussed.

6.0 Unresolved Issues

This section identifies issues which were not satisfactorily or completely resolved during the PA review. Most issues can be expected to be resolved in the course of the review through requests for additional information or during discussions between the Review Team and the DOE site. Some issues may remain unresolved due to a lack of sufficient data or knowledge, or due to competing policies or regulatory directives. Some Review Team members may enter dissenting opinions on parts of the review, and these should be discussed in this section. The significance of unresolved issues on the recommendation to the LFRG should be identified and discussed.

Because many unresolved issues may pertain to the uncertainties involved in the decisionmaking, the assumptions made, and the difficulty in agreeing or disagreeing with findings based on calculations far into the future, the PA maintenance program required by DOE Manual 435.1 can be used as an effective method for resolving these issues. The identification of studies to reduce uncertainty, analysis to justify assumptions, and the collection of data over time are all examples of conditions that should be considered for inclusion in the recommendation specifically as part of the facility's PA maintenance program. Recommendations for conditions on the PA maintenance program may allow the facility to continue to operate while the uncertainties are being studied.

7.0 Recommendation of Review Team

The Review Team must recommend that the PA be *accepted, accepted with conditions,* or *not accepted*. The basis for the recommendation should be provided, including references to the relevant material in the Review Report.

If the Review Team recommends the PA be *accepted*, this signifies that all issues concerning the results of the PA and any relationship to waste acceptance criteria, disposal facility operations, the PA maintenance program, and any other elements of the management of low-level waste were resolved. This also means that documentation in the administrative record is complete and the Review Team could identify no additional conditions that need to be placed in the Disposal Authorization Statement beyond those that have already been addressed in the section of the PA and resolved. This would be a rare finding until PAs have been reviewed through a few maintenance cycles.

If the Review Team recommends the PA be *accepted with conditions*, then the Review Team has identified some issues that could not be resolved. The team will recommend further analysis, PA maintenance activities, monitoring, or reporting that should lead to issue resolution or closure and can be specified in a Disposal Authorization Statement. Any conditions on the acceptance of the PA should be explicitly stated, with reference to the justifications for the conditions clearly identified in the materials reviewed and placed in the administrative record.

If the team recommends the PA *not be accepted*, then the Review Team has identified major issues which could not be resolved through the development and implementation of any conditions on the facility operations, waste acceptance, monitoring, or reporting. This condition would require additional rounds of review, therefore, the Review Report should clearly lay out the issues that cannot be resolved, the reasons they cannot be resolved, and any comments that provide assistance to the PA developers and the site/facility that would allow for a finding of acceptance.

Appendices

Appendices should be used to reduce the Review Report's length and provide references to important information used in the PA review.

Appendix A should include a list of the Review Team members and any consultants and their qualifications.

Appendix B should be the Review Plan used for the PA review.

Appendix C should include a chronology of the PA review that lists all communications, meetings, and other events which occurred as part of the review.

Appendix D should contain Review Team member comments or dissenting opinions which need to be reflected in the Review Report.

Appendix E should list all written communications between the DOE site and the Review Team that are considered germane to the conclusions of the review.

Appendix F should list any supporting documentation provided by the site for the PA review or used by the Review Team in making the conclusions of the review.

This documentation should include any material developed in response to questions posed by the Review Team. Additional appendices may be added to the Review Report as appropriate.

2.8.3 CA Review Report Outline

A suggested CA Review Report outline follows:

i *Executive Summary*
1.0 *Introduction*
2.0 *Summary of Facility Description and Interacting Sources*
3.0 *Summary of Composite Analysis Review*
4.0 *Technical Adequacy of Composite Analysis*
5.0 *Consistency of Composite Analysis*
6.0 *Unresolved Issues*
7.0 *Recommendation of Review Team*
8.0 *Appendices*
- *A. Review Team Members and Qualifications*
- *B. Review Plan*
- *C. Chronology of Review*
- *D. Comments from Review Team Members*
- *E. List of Important Communications Between Site and Review Team*
- *F. List of Supporting Documentation Utilized During the Review*

These suggested elements of a CA Review Report are described below.

2.8.4 CA Review Report Development

The results of the CA review using the guidance presented in Chapter 3 are to be addressed in a Review Report. This guidance is not intended to provide a comprehensive discussion for a Review Report applicable to all CAs. Instead, the Review Report should be a concise reflection of the CA review with the guidance provided in Chapter 3. The Review Report should include references to the CA, PA, and any related documentation. The conclusion of the Review Report should include the recommendation that the CA be *accepted, accepted with conditions,* or *not accepted*. The Review Report should be a final stand-alone document. Once submitted to the LFRG, no changes should be made to the final Review Report.

1.0 Introduction

This section provides a brief introduction on the purpose of the report, and includes a citation of the CA being reviewed and the guidance used to conduct the review. If the associated PA is a separate document, the PA citation should be included. There should also be a concise statement of the review process and Review Team findings, as well as an overview of the report contents.

2.0 Summary of Facility Description and Interacting Source Terms

This section provides sufficient background to readers of the Review Report who are unfamiliar with the disposal facility and potential contributing sources. This section provides a concise description of the overall geographic area addressed in the CA, of the LLW disposal facility and all potential sources that could interact with the disposal facility. This section should also identifies those potential sources which were not considered in the CA and a concise explanation why they were excluded. The material in this section could be extracted from the CA, and may include material abstracted from the PA.

3.0 Summary of Composite Analysis Review

This section provides an overview of the CA review. References to appendices that identify the members of the Review Team and consultants to the Review Team and the chronology of the review are appropriate. Documentation from the site that was prepared in response to requests for additional information by the Review Team should be discussed briefly, with references to the documentation itself. Issues identified during the course of the review and the resolutions should be documented in this section. Any appendices containing minutes or summaries of extended discussions of the Review Team can be referenced. The conclusions of the review should also be presented in this section.

4.0 Technical Adequacy of the Composite Analysis

This section provides discussion of the following aspects of the CA:

- Summary of the method of analysis and the calculated results;
- Required options analyses; and
- Required ALARA analyses.

This section also provides discussion on the following aspects of the review:

- Findings on CA completeness, thoroughness, technical supportability and quality of the conclusions of the CA;
- Major technical issues relating to the technical adequacy of the CA; and
- The basis for concluding that the CA is technically adequate and provides reasonable conclusions relative to the performance measures for environmental and public radiation protection in DOE Order 5400.5.

5.0 Consistency of Composite Analysis

This section documents the consistency of the CA with the *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses.* There should be a discussion of how the guidance was interpreted for the CA, and a judgment on the consistency of approach with respect to the guidance. In the judgment of consistency, consideration of the interpretations made for existing laws, regulations, other DOE Orders, DOE policy, and applicable agreements with regulatory agencies or affected states should be included. Conflicts with the CA guidance or other competing regulatory matters and the approaches taken in the CA in addressing these conflicts, should be identified. The significance of any inconsistencies with respect to the acceptance of the CA should also be discussed.

6.0 Unresolved Issues

This section identifies issues which were not satisfactorily or completely resolved in the CA review. The review of the CA is likely to identify issues to be addressed. Most of these issues were expected to be resolved in the course of the review by requests for additional information or discussions between the Review Team and the DOE site. Some issues, however, remain unresolved because of insufficient data or knowledge, or because of competing policies or regulatory directives. Some Team members may enter dissenting opinions on parts of the review. If so, these should be discussed in this section. Moreover, the significance of these unresolved issues on the Review Team's recommendation to the LFRG should be identified and discussed.

7.0 Recommendation of the Review Team

The Review Team must recommend that the CA be *accepted, accepted with conditions,* or *not accepted*. The basis for the recommendation should be provided, including references to the relevant material in the Review Report.

If the Review Team recommends the CA be *accepted,* this means that all issues concerning the results of the CA are resolved. The documentation in the administrative record is complete and that a Disposal Authorization Statement should be issued.

If the Review Team recommends the CA be *accepted with conditions,* then the Review Team has identified some issues that could not be resolved to their full satisfaction, but has identified further analysis, monitoring, or reporting that should be implemented in the corrective actions identified in the options analysis included in the CA and as conditions in the Disposal Authorization Statement. Conditions on the acceptance of the CA should be explicitly stated, with reference to the justifications for the conditions clearly identified in the materials reviewed and placed in the administrative record.

If the Review Team recommends the CA *not be accepted,* then the Team has identified major issues which could not be resolved through the development and implementation of any conditions on the operations, waste acceptance, monitoring, or reporting by the facility. It is expected that a "non-acceptance" would require additional rounds of review, therefore, the Review Report needs to clearly lay out the issues that cannot be resolved, the reasons they cannot be resolved, and comments that would provide assistance to the CA developers and the site/facility in providing the analysis or data that would allow for a finding of acceptance.

Appendices

Appendices should be used to reduce the Review Report's length and provide references to important information used in the CA review.

Appendix A lists the Review Team members, consultants and their qualifications.

Appendix B contains the Review Plan used for the CA review.

Appendix C includes a chronology of the CA review a list of all communications, meetings, and other events which occurred as part of the CA review.

Appendix D provides Review Team member comments and/or dissenting opinions that need to be reflected in the Review Report.

Appendix E lists all written communications between the site and the Review Team considered germane to the conclusions in the Review Report.

Appendix F lists supporting documentation provided by the site for the CA review or used by the Review Team. This documentation should include any material developed in response to questions posed by the Review Team.

Additional appendices may be added to the Review Report as appropriate.

2.8.5 Review Report Approval

The Review Team should review the initial report for adequacy and accuracy and prepare a draft report. The draft Review Report should be provided to the affected DOE field office management for a factual accuracy review. Site comments should be reviewed by the Review Team and incorporated in the final Review Report as appropriate. The final Review Report, together with a summary of the site review comments and the Review Team's response to those comments should be submitted to the LFRG for review and approval.[1]

2.9 Disposal Facility Compliance Evaluation

Upon completion of the Review Reports, the LFRG begins its deliberations on the PA and CA and whether to recommend approval by the cognizant Deputy Assistant Secretary. During these deliberations, the LFRG considers: the Review Report and the recommendations of the Review Team concerning the PA and/or CA; unresolved issues identified in the Review Report; issues which may have been identified after the report was submitted; and any additional information that may have been provided to the LFRG for consideration. If the LFRG concludes that the document is acceptable, the Review Team will prepare a Compliance Evaluation for the PA and/or CA.

If the PA and CA are submitted simultaneously, the LFRG can complete the review process and immediately follow-up with the development and submission of the Disposal Authorization Statement, if justified. This effort would require the development of the Compliance Evaluation, pertinent supporting documentation and a draft Disposal Authorization Statement prior to formal submission to the cognizant Deputy Assistant Secretary.

If the PA and CA are not submitted at the same time, and the PA review is completed without the CA, then the following steps in development of a Compliance Evaluation and Disposal Authorization Statement should be modified appropriately. A suggested approach for the LFRG to consider if the PA and CA are submitted separately is in Section 4.4.2.

2.9.1 Issues Resolution

During the development of the Review Report, issues which were unresolved may become conditions for facility operation. The LFRG may decide that some or all of the issues should be resolved, or the recommendations of the Review Team modified, prior to the development of a Compliance Evaluation and/or Disposal Authorization Statement. If this is the action taken by the LFRG, the LFRG should not make any changes to the Review Report. Instead, the resolution or modification of conclusions concerning these issues should be thoroughly documented with issues papers, analyses, briefing minutes, and meeting minutes, and added to the administrative record for

[1]The LFRG member from the affected DOE field office has a vested interest in a PA and/or CA Review Report for a site under the authority of his/her field office. However, his/her position and perspective are important for comprehensive evaluation of the PA and CA, so he/she may participate in discussions and votes.

the PA/CA review. Resolution or modifications to these issues should be discussed in the Compliance Evaluation transmitted to the cognizant Deputy Assistant Secretary.

The LFRG should consider meeting with the Review Team members and site/facility personnel involved in the development of the PA and/or CA to assist in the resolution of unresolved issues that are identified in the Review Report.

2.9.2 LFRG Review of a PA Review Report

The LFRG thoroughly reviews the PA Review Report; assimilates the necessary information from the appendices and the administrative record; evaluates the PA, additional information or issues discussed after the submittal of the Review Report, and addresses the following subjects:

(1) DOE Order 435.1 Compliance

The LFRG determines if the PA, as reviewed by the Review Team and discussed in the Review Report, provides a reasonable expectation that the performance objectives of DOE Order 435.1 are met for the LLW disposal facility evaluated in the PA. The criterion for reasonable expectation is a "weight of evidence" determination that is based on the material included in the PA, supplemental documentation, and the Review Report.

(2) Conditions of Acceptance

The recommendation of the Review Team that the PA be *accepted, accepted with conditions,* or *not accepted* should be reviewed and discussed in consideration of any unresolved issues in the Review Report. The LFRG evaluates conditions identified by the Review Team. Each condition of acceptance identified by the Review Team should be justified in the Review Report. The LFRG should settle unresolved issues identified in the Review Report and document the resolutions. Should these resolutions lead to modifications of the conditions for acceptance identified by the Review Team, changes to the conditions for acceptance should be made and documented. The use of the PA maintenance program to reduce uncertainties should be examined carefully to ensure that the goals of those conditions, as proposed by the Review Team, are both useful and reasonable.

New issues identified following the PA review should be discussed. Conditions for acceptance of the PA should be developed, and the basis for the new conditions should be documented. The final conditions for acceptance of the PA should be agreed upon by the LFRG. These final conditions and the justification of these conditions by the Review Report or other information should be documented as part of the decision of the LFRG.

(3) Acceptance of the PA

In addition to the PA, the basis for its acceptance should include:

- The Review Report;
- The administrative record;
- Evaluations by the LFRG; and
- Conditions imposed on acceptance of the PA.

The LFRG should review this material and conclude whether the PA should be accepted and recommended for approval. Acceptance of the PA and associated documentation means the LLW disposal facility can be expected to operate under specified conditions with a reasonable expectation that the performance objectives of DOE Order 435.1 will be met. [Approval of the PA and associated documentation also means the LLW disposal facility should be issued a Disposal Authorization Statement, provided that a recommendation for approval is also made following the review of the CA (See Section 2.9.6)].

2.9.3 PA Compliance Evaluation Development

The findings of the LFRG should be documented in a Compliance Evaluation to be submitted to the cognizant Deputy Assistant Secretary for approval. If the LFRG does not recommend approval of the PA, then the recommended steps to be taken by the DOE site to gain acceptance and approval should be documented and submitted to the cognizant Deputy Assistant Secretary for transmittal to the field office manager.

If the LFRG recommends approval of the PA, a Compliance Evaluation documenting its approval should be prepared by the LFRG and submitted to the cognizant Deputy Assistant Secretary.

Essential elements of the Compliance Evaluation include:

- A summary of the findings on the subjects described in Section 2.9.2;
- Conditions on the PA maintenance program;
- Conditions on disposal operations;
- Conditions on waste acceptance and receipt;
- Conditions on monitoring;
- Conditions on recordkeeping; and

- Other pertinent information needed to maintain reasonable expectation that the performance objectives of DOE Order and Manual 435.1 will be met.

Failure to satisfy conditions on acceptance of the PA could lead to rejection of the Disposal Authorization Statement for the subject facility and/or shut down of the facility. The Compliance Evaluation should include a draft Disposal Authorization Statement with the proposed conditions for the facility to meet that the cognizant Deputy Assistant Secretary may issue if the Disposal Authorization Statement is approved.

2.9.4 LFRG Review of a CA Review Report

The LFRG thoroughly reviews the CA Review Report; assimilates the necessary information from the appendices and the administrative record; evaluates the CA, including issues discussed after the submittal of the Review Report; and addresses the following subjects:

(1) Conclusions Concerning Performance Measures

The LFRG will make two determinations about the CA based on the Review Report conclusions. First, the LFRG will determine whether the CA provides a reasonable expectation that disposal facility operation is unlikely to result in long-term compliance problems. Second, the LFRG will determine whether the CA provides for appropriate management alternatives and corrective actions in the event that potential problems are identified. "Appropriate management alternatives and corrective actions" must yield a reasonable expectation that current LLW activities will not result in the need for future corrective or remedial actions.

Corrective actions are to be identified for LLW disposal facilities and other contributing sources which exceed the constraining performance measure. The corrective actions must provide a reasonable expectation that the constraining performance measure will not be exceeded in the future. The corrective actions should provide a reasonable first line of defense. Examples of corrective actions that should be proposed are:

- Refining the analysis to reduce conservatism;
- Limiting receipt of certain wastes until further information is collected;
- Evaluating remedial measures on interacting source terms; and
- Evaluating alternative land use plans.

Additional discussion of CA corrective actions can be found in the *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*.

The LFRG determination is based on the material presented in the CA, Review Report, and supplemental information developed for the review. The recommendation on acceptance of the CA should be supported by the Review Report and conditions placed on such a recommendation.

(2) Conditions of Acceptance

The Review Team may recommend that the CA, *be accepted*, *accepted with conditions*, or *not accepted*. Review and discussion of the recommendation should consider unresolved issues in the Review Report and any other issues or information identified following the CA review. The LFRG will either concur with any conditions recommended by the Review Team or modify the recommendations based on other issues or information. If the LFRG elects to modify the recommendations of the Review Team, the justification for any modifications should be documented. The LFRG is to settle any unresolved issues identified in the Review Report and document the resolutions. If these resolutions lead to modifications of the conditions for acceptance identified by the Review Team, changes to the conditions for acceptance must be made and documented. New issues not identified by the Review Report that were identified following the CA review are to be discussed. Any conditions needed to address the issues for acceptance of the CA must be developed and the basis for the new conditions documented.

The final conditions for acceptance of the CA are to be agreed upon by the LFRG. These final conditions and the justification of these conditions by the Review Report or other information must be documented as part of the decision of the LFRG.

(3) Acceptance of the CA

The CA, Review Report, administrative record, evaluations by the LFRG, and any conditions for acceptance of the CA form the basis for accepting the CA. The LFRG should review this material and conclude whether the CA should be accepted and recommended for approval. Acceptance of the CA means the LLW disposal facility can be expected to operate under the specified conditions without the constraining dose limits being exceeded. If the CA (and the corresponding PA) are approved, a Disposal Authorization Statement should be issued for the facility (See Section 2.9.6).

2.9.5 CA Compliance Evaluation Development

The findings of the LFRG are documented in a Compliance Evaluation to be submitted to the cognizant Deputy Assistant Secretary for approval. In some cases, the LFRG may not accept the CA and not recommend approval of the CA. If so, the recommended steps to be taken by the DOE site to gain acceptance and approval should be documented and submitted to the cognizant Deputy Assistant Secretary for transmittal to the field office manager.

If the LFRG accepts the CA and recommends its approval by DOE, a Compliance Evaluation documenting approval of the CA will be prepared by the LFRG and submitted to the cognizant Deputy Assistant Secretary.

Essential elements of the Compliance Evaluation include:

- A summary of the findings on the subjects described in Section 2.9.4;
- Conditions for acceptance of the CA; and
- Other pertinent information needed to assure appropriate planning for continued protection of the public from radioactive material disposed in the facility.

The Compliance Evaluation should include a draft Disposal Authorization Statement with appropriate proposed conditions. The cognizant Deputy Assistant Secretary may approve the draft Disposal Authorization statement as final.

2.9.6 Development of Disposal Authorization Statement

The LFRG develops a draft Disposal Authorization Statement that authorizes the operation (or continued operation) of the LLW disposal facility evaluated in the PA and CA. The statement is based on the results of the PA and CA reviews as documented in the Compliance Evaluations, and specifies the conditions under which the LFRG would permit the operation to continue. The assistance of the Review Team Leader should be solicited if necessary for developing the Disposal Authorization Statement.

References to the PA, CA, and other procedures and facility-specific documents should be included to ensure operational controls that are expected to be followed are clearly identified. Deadlines for submittal of information or data, and specific measures of performance should be identified for clarity. The expiration date for the Disposal Authorization Statement should be clearly indicated, as well as expiration dates for any interim conditions.

Chapter 4 provides additional guidance on preparation of Disposal Authorization Statements.

2.9.7 Compliance Evaluation/Disposal Authorization Statement Approval

The Compliance Evaluations and Disposal Authorization Statement undergo a thorough internal (LFRG) review for adequacy and accuracy, both during preparation and prior to final transmittal. The LFRG completes the final Compliance Evaluations and draft Disposal Authorization Statement, and transmits them to the cognizant Deputy Assistant Secretary for final approval and signature. The LFRG also transmits any documentation such as the Review Report and documentation of resolution of issues that will assist the Deputy Assistance Secretary's understanding of the Compliance Evaluations and Disposal Authorization Statement. The cognizant Deputy Assistant Secretary should then take the appropriate action on the approval package in accordance with his management responsibilities.

Additional details on approval of Compliance Evaluations and Disposal Authorization Statements are presented in Chapter 4.

2.10 Review Closeout

2.10.1 Review Feedback

The LFRG PA and CA review for a site includes an opportunity for evaluation and feedback by Review Team members, the staff responsible for the site/facility being reviewed, the LFRG, and other DOE organizations (e.g., EM, EH, field offices) involved with or affected by the review. If requested by the site/facility being reviewed, a meeting between the LFRG, Review Team members, and site personnel should be convened to provide for an understanding of the results of the review and the conditions recommended in the Disposal Authorization Statement.

2.10.2 Final Administrative Record

During the PA and/or CA review process, the Review Team Leader assembles the administrative record. Following approval of the Disposal Authorization Statement by the cognizant Deputy Assistant Secretary, the statement should be placed in the administrative record, and the review considered closed.

The administrative records for all PA and CA reviews will be stored and maintained in a central location. The LFRG Co-Chairs will identify the location at Headquarters and the affected sites will be responsible for maintaining records relevant to their facility/facilities.

If the LFRG decides to take additional actions with respect to the disposal facility, then documentation of these actions will be placed into the same administrative record. When another substantive review of a PA and/or CA for the same disposal facility is conducted, for example, during a PA maintenance cycle, then the LFRG should use the same administrative record. The administrative record then becomes a comprehensive record of disposal authorization decisions through all or remaining operations at the facility, similar to a docket file for a facility licensed by the NRC.

2.10.3 Conditions Tracking

The LFRG is responsible for ensuring that completion of actions or adherence with conditions specified in the Disposal Authorization Statement are tracked and a status provided to the cognizant Deputy Assistant Secretary, if requested. Completion of other commitments or actions of the site and/or LFRG related to the PA/CA review, but not specified in the Disposal Authorization Statement (e.g., commitment to update LFRG guidance), should also be tracked by the LFRG.

3. TECHNICAL REVIEW CRITERIA

The framework and technical review criteria for Review Teams to evaluate low-level radioactive waste disposal facility PAs and CAs are contained in Section 3.

Performance Assessments and Compliance Analyses are technical studies that are prepared with considerable engineering and professional judgment. As a result, they contain arguments and discussions that often do not lead to absolute results or conclusions that are absolutes. The Review Team must include these perspectives when reaching conclusions on the review of PAs and CAs. A key objective of the technical review of a PA or CA is to verify incorporation of and appropriate support for:

- Relevant and important technical discussions;
- Analyses and methodologies; and
- Supporting data and information.

It is also important that this material include articulation of nuances of technical and engineering judgment.

The following sections include acceptance criteria for PA and CA reviews. In many cases, the acceptance criteria are followed by sub-criteria that describe the minimum information expected or other guidance on how each of the acceptance criteria can be measured. These acceptance criteria are to be used as guidance in the reviews of the PAs and CAs by the Review Team, and for preparing the Review Reports discussed in Section 2.8.

The technical criteria presented in this chapter have been formulated through prior PA reviews and consideration of a "generic" situation. They provide benchmarks to be addressed in the review of PAs and CAs and provide direction to ensure the review satisfies its objectives. In the conduct of a specific review, modifications to these criteria or additional criteria may be required for determining the acceptability of site-specific information. Review Teams must document the changes and additions to these criteria in the Review Report for specific PA/CA reviews.

3.1 PA Review Criteria

The Review Team must make the following fundamental conclusions, called review findings, if a PA is to be accepted:

- The PA is complete.
- The PA is thorough and technically supported.
- The PA conclusions are valid and acceptable.

Each of these review findings can be made using the acceptance criteria presented in the following subsections. The acceptance criteria are intended to provide guidance and should be addressed in the review commensurate with the importance of each criterion to the performance of the site and disposal facility, and to the results and conclusions of a PA for evaluating LLW disposed after

September 26, 1988. The criteria provide a thorough listing of topics to be addressed in the course of the review and present the basis for any requests for additional information concerning a disposal facility or the PA.

3.1.1 *Review Finding I - The PA is Complete*

To declare a PA complete, the Review Team must determine the following:

- Material considered to be significant in understanding the PA and associated analysis is available so that a detailed review can be performed.

- The PA must address each of the topics identified in the *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*, and the PA discussion must contain sufficient information for the review.

- The material presented in the PA is representative of current and available knowledge, does not overlook known information, and includes supporting information.

- The arguments and discussions included in the PA have technical merit, and the conclusions represent reasonable interpretations of the results for the long-term performance of the LLW disposal facility and as presented with the supporting data.

- The steps of the analysis follow logically one after another, and there are no extraneous discussions or unjustified assumptions.

- The methodology of analysis evaluates the important features of the site and the disposal facility and demonstrates an understanding of the site and facility.

- The methodology of analysis is clearly explained, the assumptions and performance measures are clearly presented, including justifications, and the results of the application of the methodology of analysis are clearly presented and interpreted to formulate the conclusions.

The following acceptance criteria address these review findings and provide the basis for identifying questions to be addressed and requests for additional data or information concerning a disposal facility or PA.

Criterion 1. The PA identifies the performance measures and a justification for their use to achieve site-specific applications of the performance objectives. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.a.)

Criterion 2. The PA presents information on the following that is sufficient to support the analysis presented in the PA: site geography, demography, land use plans, meteorology, ecology, geology,

seismology, volcanology, surface water and groundwater hydrology, geochemistry, geologic resources, water resources, and natural background radiation. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.b.)

Criterion 3. The PA presents information on the facility design features that address water infiltration, disposal unit cover integrity, structural stability, and the inadvertent intruder barrier sufficient to support the analysis presented in the PA. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.c.)

Criterion 4. The PA identifies Federal, state, and local statutes, regulations, and agreements that may impact site engineering, facility design, or facility operations. The PA also describes the impacts of those statutes, regulations, and agreements that may be precipitated by the PA results. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.d.)

Criterion 5. The PA identifies procedures and facility related documentation (e.g., Safety Analysis Report, Operational Readiness Review, Waste Acceptance Criteria) that may impact site engineering, facility design, or facility operations. The PA also describes the impacts of procedures and documents that may be precipitated by the PA results. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.e.)

Criterion 6. The PA identifies and justifies the key assumptions included in the analysis. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.f.)

Criterion 7. The PA identifies the point of assessment (see Figure 3-1) for each performance measure, and justifies the selection of each point of assessment. The point of assessment is the location for which compliance with the performance objectives is evaluated. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.g.)

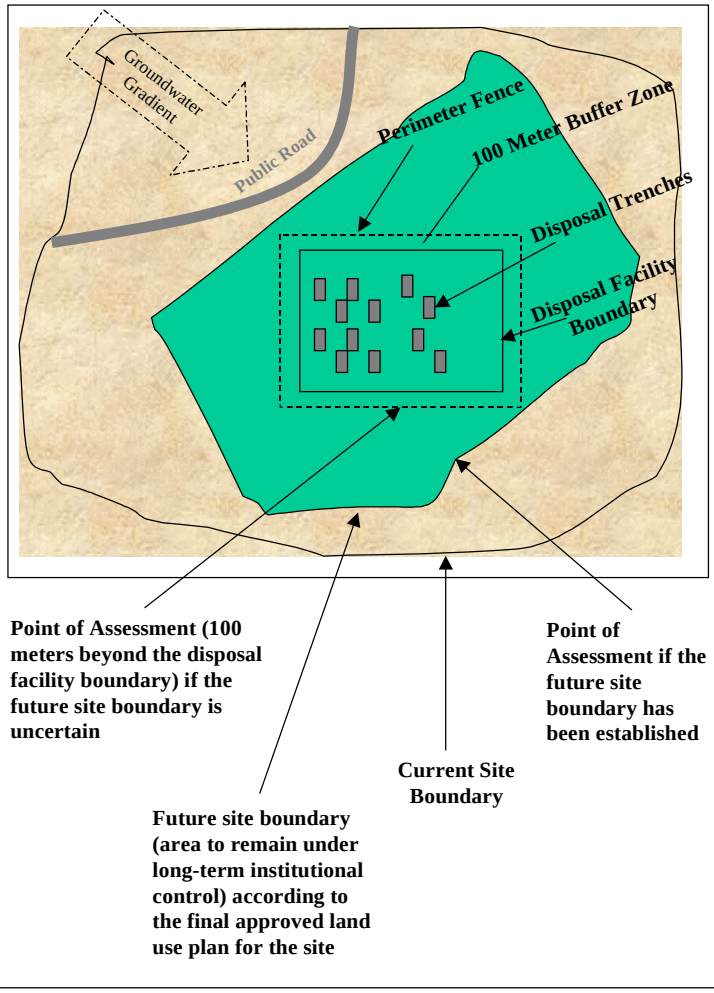
7a. The point of assessment for all pathways, the air pathway excluding radon, and groundwater resource protection is justified based on future land use. If the future site boundary is uncertain, a reasonable point of assessment (e.g., point of maximum impact greater than 100-m from the edge of the disposal unit) is justified. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.g.1.)

7b. The default point of assessment for the performance measure for radon exposure that is based on a limit on the average flux of radon of 20 $pCi/m^2/s$ at the ground surface is the ground surface over the disposal unit. (An illustration of the

application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.g.2.)

7c. The default point of assessment for the alternative performance measure for radon exposure that is based on a limit on air concentration of radioactive material of 0.5 pCi/L is 100-m from the edge of the disposal unit. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.g.3.)

Figure 3-1. Illustration of the Term "Point of Assessment"



Criterion 8. The PA identifies and quantifies all radionuclides present in the low-level waste to be disposed of at the facility that could significantly contribute to dose for the all pathways analysis, the air pathway analysis, the groundwater analysis, and the intruder analysis. Technical justification is provided for those radionuclides considered in detail in the analyses, and conversely, those not considered in the analyses. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.h.)

Criterion 9. The PA accounts for all relevant mechanisms for the release of radionuclides from the waste materials for environmental transport. The mechanisms analyzed are justified by references to relevant studies, available data, or supporting analyses in the PA. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.i.)

Criterion 10. The PA provides a complete and clear description of the conceptual model of the environmental transport of radionuclides from the waste materials to the points of compliance by air and water. The conceptual model is justified by referenced investigations, data, and supporting analyses that are representative of the site-specific conditions described. (An illustration of the

application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.j.)

10a. The conceptual model incorporates interpretations of available geochemical, geologic, meteorologic and hydrologic data, and the relevant mechanisms that have a significant effect on the transport of radionuclides at the disposal site. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.j.1.)

10b. Assumptions incorporated into the conceptual model to account for transport mechanisms lacking sufficient data or supporting analyses are identified and justified as reasonable representations of site behavior over the time period considered in the analysis. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.j.2.)

10c. The conceptual model includes closure of the facility as justified based on referenced closure plans or reasonable assumptions of facility closure. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.j.3.)

10d. The conceptual model includes any credits to be taken in the analysis for the performance of engineered features. Credits for engineered features include a reasonable representation of the degradation of the engineered features that is justified by supporting investigations and data. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.j.4.)

10e. The conceptual model includes natural processes that affect the transport of radionuclides (e.g., flooding, mass wasting, erosion, weathering) over the time period considered in the analysis, as justified based on referenced investigations and supporting analysis. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.j.5.)

Criterion 11. The PA provides a clear description of the mathematical models used in the analysis, the basis for their selection, and their linkage. The mathematical models selected are justified and provide a reasonable representation of all of the elements of the conceptual model. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.k.)

11a. The complexity of the mathematical models selected is commensurate with the available site data. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.k.1.)

11b. Assumptions incorporated into the mathematical models are identified, justified, and consistent with the conceptual model. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.k.2.)

11c. Mathematical models selected are documented and verified either in referenced publications or in the appendices of the PA. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.k.3.)

Criterion 12. The PA provides a complete description of the important exposure pathways and scenarios for the specific disposal facility that are used in the evaluation of the potential doses to hypothetical members of the public and inadvertent intruders consistent with site-specific environmental conditions and local and regional practices. The exposure pathways and scenarios selected for detailed analysis are justified as conservative representations of the long-term performance of the LLW disposal facility. These include: (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.l.)

12a. Exposure pathways from the transport of contamination in groundwater that may be considered to include potential exposures from the ingestion of contaminated groundwater, the use of contaminated groundwater for irrigation and livestock watering, and the biotic uptake and transport of contamination from groundwater and surface water. Potential exposure pathways from the transport of contamination in surface water include the ingestion of contaminated surface water and contaminated fish. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.l.1.)

12b. If radiation dose is used as a measure of groundwater resource protection, the exposure scenarios consider the ingestion of water (at 2 liters per day or an alternative rate, if a justification is included) at the point of assessment, which represents the location of maximum exposure from a well constructed and developed using current practices typical for the local area. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.1.2.)

12c. Exposure scenarios from the transport of contamination in water for the all pathways analysis considers the use of groundwater and surface water consistent with local and regional practices. Exposure scenarios that may be considered include drinking water, crop irrigation and livestock watering, the ingestion of dairy products, livestock, fish, crops, and soil, the inhalation of resuspended particles, and external exposure. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.l.3.)

12d. Exposure pathways from the transport of contamination in the atmosphere that may be considered include potential exposure from immersion in air contaminated with volatile and nonvolatile radionuclides, deposition of volatile and nonvolatile radionuclides, and subsequent exposure from direct radiation, ingestion, and resuspension. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.l.4.)

12e. Exposure scenarios from the transport of contamination in air that may be considered include residential and gardening activities which include the direct inhalation of volatile and nonvolatile radionuclides, external exposure, ingestion of crops, soil, livestock, dairy products, and inhalation of resuspended particles. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.l.5.)

12f. Exposure pathways from inadvertent intrusion into the waste disposal units identify the chronic and acute exposure pathways for each of the exposure scenarios considered. The exposure pathways include all relevant ingestion, external exposure, and inhalation pathways for each exposure scenario. [Direct ingestion of contaminated groundwater and exposures to radon should not be considered for inadvertent intrusion, because they are considered separately.] (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.l.6.)

12g. Acute exposure scenarios for inadvertent intrusion considers direct intrusion into the disposal site and exhumation of accessible waste material. Relevant scenarios that may be considered include discovery, residential construction, and well drilling that incorporate external exposure, inhalation of resuspended particles, and ingestion of particles. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.l.7.)

12h. Chronic exposure scenarios for inadvertent intrusion consider direct intrusion into the disposal site and exhumation of accessible waste material. Relevant scenarios that may be considered include residential use and post-construction, and post drilling agricultural use, that incorporate the ingestion of foodstuffs, ingestion of soil, external exposure, and inhalation of resuspended particles. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.1.8.)

Criterion 13. The PA provides a coherent presentation of the relevant descriptive information concerning the site, the disposal facility, the waste characteristics that are reflected in the conceptual model, and the selection of the mathematical models used in the analysis. The descriptive information and the approach to modeling provide the necessary results to evaluate the exposure pathways and scenarios that are important to assess the performance of the disposal facility. (An

illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.m.)

Criterion 14. The calculated results presented in the PA are demonstrated to be consistent with the site characteristics, the waste characteristics, and the conceptual model of the facility. The demonstration of consistency is supported by available site monitoring data and supporting field investigations. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.n.)

Criterion 15. The models used for calculating the results presented in the PA are analyzed to identify the sensitive parameters in the analysis. The results of the sensitivity analysis are used to evaluate the uncertainty in the calculated results. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.o.)

Criterion 16. The results of the sensitivity and uncertainty analyses are interpreted as they relate to establishing reasonable assurance that the conclusions of the PA are correct. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.p.)

Criterion 17. The PA integrates the results of the analysis, the uncertainty analysis, the performance measures, waste acceptance criteria, operating procedures, and applicable laws, regulations, policies and agreements to formulate conclusions. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.q.)

Criterion 18. The PA includes an interpretation of the results that allows for a comparison to the performance measures used in the PA, and include any necessary limitations on facility design or operations that are required to meet the performance objectives. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.r.)

Criterion 19. The PA discusses the quality assurance measures applied to the preparation of the analysis and its documentation. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.s.)

Criterion 20. The PA includes an ALARA analysis, and if appropriate, the analytical methods for the ALARA assessment are described. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.t.)

Criterion 21. The PA includes appendices or references to published documents and/or data that provide a basis for the discussions and analysis in the PA. (An illustration of the application of this criterion to evaluate whether a specific PA is complete is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.1.u.)

3.1.2 *Review Finding II - The PA is Thorough and Technically Supported.*

In order to declare that the PA is thorough and technically supported, the Review Team must determine the following:

- The PA is a comprehensive examination of the long-term performance of the disposal facility that includes sufficient analyses to support the conclusions.

- The analysis is representative of the available knowledge of site behavior and is a comprehensive representation of that knowledge.

- Sufficient depth of analysis is presented in the evaluations of radionuclide inventory, physical and chemical characteristics of waste, the conceptual models, the key assumptions incorporated into the models, and the sensitivity and uncertainty analysis to support the conclusions.

- The PA analysis includes technically correct methodologies and calculations.

- The methodology of analysis is justified and based on site data. Pathways and scenarios addressed in the analysis are justified, and are reasonable representations of the site and disposal facility.

- The models used in the analysis are justified and based on site data.

- The parameters and input data in the analysis are justified and representative of the site and disposal facility.

- The results determined from the models used are verified and consistent with available site information, the conceptual model, and monitoring data, and no inconsistencies or errors are present.
- The sensitivity and uncertainty of the calculated results are analyzed for all aspects of the assessment that have a significant effect on the conclusions of the PA.

- The results are interpreted to provide a comprehensive understanding of the long-term performance of the disposal facility, and the conclusions are based on the interpretations of the results.

- The conclusions are incorporated into the disposal facility design and operations.

The following acceptance criteria address this review finding. These criteria can be used to examine the thoroughness of the analysis presented in the PA, and as the basis for requesting additional information to provide a reasonable expectation that the conclusions of the PA are consistent with site and facility information and are justified and defensible.

Criterion 1. The PA presents an estimate of the radionuclide inventory of the radioactive waste disposed of and to be disposed of at the facility which is quantified and technically supported by records, data, studies, and evaluations. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.a.)

> *1a.* All of the radionuclides disposed and anticipated to be present in wastes to be disposed of are evaluated in the PA. Radionuclides screened from detailed analysis or having no inventory limit are identified, and the bases for these conclusions are supported and defensible. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.a.1.)
>
> *1b.* Estimates of the radionuclide inventory for past waste disposals are described and to the extent practical are based on past waste disposal records, a reasonable expectation of actual waste content based on a knowledge of the processes that generated the waste, calculations, sampling data, technical studies, and reasonable projections of waste to be disposed. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.a.2.)

Criterion 2. The physical and chemical characteristics of the waste disposed of in the past that affect the release and transport of radionuclides are identified. The physical and chemical characteristics of the waste form are quantified and supported by laboratory or field studies, or are based on referenced documentation. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.b.)

Criterion 3. Any inventory limits are developed from reasonable projections of waste to be disposed and analyses that consider the physical and chemical characteristics of the wastes if those characteristics affect the release and transport of radionuclides. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.c.)

Criterion 4. The conceptual model is a reasonable interpretation of the existing geochemical, geologic, meteorologic, hydrologic, and monitoring data for the site and disposal facility. The components of the conceptual model for the transport of radionuclides that are important to the conclusions relating to the long-term performance of the disposal facility are thoroughly analyzed. The assumptions incorporated into the conceptual model are consistent with the available data, related investigations, and theory related to the conceptual model. Parameters included in the conceptual model are supported by data or related investigations relevant to the site and disposal facility. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.d.)

Criterion 5. The assumptions of the PA related to the waste, site, and facility design and operations which are critical to the conclusions of the PA are supported and the uncertainties associated with these assumptions are analyzed as part of the PA. Credits for the performance of engineered features and site closure included in the conceptual model are based on data derived from field investigations, related investigations, or documented sources of information relevant to the site and disposal facility. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.e.)

Criterion 6. The conceptual model for the source term, groundwater flow, and radionuclide transport includes parameters for unsaturated and saturated flow, total and effective porosity, hydraulic conductivity, water retention, relative permeability relationships, volumetric water content, retardation, and diffusion that are based on data, related investigations, or documented references relevant to the site and disposal facility. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.f.)

Criterion 7. The mathematical models used in the PA for analyzing air and water transport of radionuclides are appropriate for the disposal facility and disposal site. The selected models provide a justified representation of the technically important mechanisms identified in the conceptual model, and provide calculated results that are a defensible basis for formulating conclusions. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.g.)

7a. The input data for the mathematical models are derived from field data from the site, laboratory data interpreted for field applications, or referenced literature sources which are applicable to the site. Assumptions which are used to formulate input data are justified and have a defensible technical basis. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.g.1.)

7b. Intermediate calculations are performed and results are presented that demonstrate, by comparison to site data or related investigations, that the calculations of the mathematical models used in the PA are representative of disposal site and facility behavior for important mechanisms represented in the mathematical models. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.g.2.)

7c. Representations of groundwater well performance (e.g., construction, diameter, yield, depth of penetration, screen length) are reasonable reflections of regional practices and are justified. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.g.3.)

7d. The mathematical models are tested, by comparison to analytical calculations or other models, to demonstrate that the results are consistent with the conceptual model, physical and chemical processes represented in the models, and available site data. The models are evaluated for defensibility and are reasonable representations of the disposal site and facility performance by comparison to available site data, related technical investigations, or referenced documentation or literature. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.g.4.)

7e. The initial conditions, the boundary conditions, and the changes of properties over time for the mathematical model are analytically correct (i.e., well posed), and derived from existing site data and information. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.g.5.)

Criterion 8. The dose analysis considers the exposure pathways and transfer factors and calculates the maximum dose using acceptable methodologies and parameters. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.h.)

8a. The dose analysis for exposures to radionuclides identifies the transfer coefficients between media and justifies the parameters used in the analysis with supporting data or references to the literature. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.h.1.)

8b. The dose analysis specifies the consumption of radioactively contaminated materials for the exposure pathways evaluated, the inhalation rates of contaminated materials, and the external exposure rates and conditions for radioactive materials. These parameters are justified using references to the literature or site-specific investigations. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.h.2.)

8c. The dose analysis is conducted using effective dose equivalents in accordance with ICRP-30 (1979) and uses dose conversion factors from recognized published sources. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.h.3.)

8d. The maximum dose projected for 1000 years after facility closure at the point of compliance is used in the analysis for evaluating disposal of LLW or establishing waste acceptance criteria for future disposals. (An illustration of the application of

this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.h.4.)

Criterion 9. The sensitivity and uncertainty analysis considers those parameters and mechanisms that are important to the conclusions relating to the long-term performance of the disposal facility, including radionuclide inventory, radionuclide characteristics, release rates, site and facility characteristics, groundwater flow parameters, site meteorology, and radionuclide transport parameters. Parametric and mechanistic variations analyzed in the uncertainty analysis that are important to the conclusions are justified as reasonable for the site and facility using data or related field investigations. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.i.)

9a. The parameters important to the components of the analysis are analyzed to identify the sensitive parameters, and the selection of sensitive parameters is quantitatively justified. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.i.1.)

9b. The sensitive parameters are analyzed for uncertainty in the results of the analysis to provide quantitative bounds for interpreting the results of the analysis. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.i.2.)

9c. The results of the sensitivity and uncertainty analyses are determined using a prescribed methodology that is technically justified. The results of the analysis provide the necessary information to justify the assumptions and conclusions of the PA. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.i.3.)

9d. The maximum projected dose and time of occurrence are presented in the PA to provide for understanding of the natural system being modeled and the behavior of the model. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.i.4.)

Criterion 10. The ALARA analysis provides a cost-benefit analysis that is an optimization of the collective or population dose based on the cost of dose reduction in the exposed population of $1,000 to $10,000 per person-rem averted. (ALARA analysis is not required if the projected individual or collective doses in the exposed population are trivial.) (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.j.)

Criterion 11. The inadvertent intruder analysis considers the natural and man-made processes that impact the possible exposure to an intruder and calculates the dose using acceptable methodologies and parameters. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.k.)

11a. The inadvertent intruder analysis specifies the reductions in concentrations of radioactive material from mixing with uncontaminated material or the transport of radionuclides from the disposed waste mass, and justifies the parameters used in the analysis with site data, supporting analysis, or referenced information. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.k.1.)

11b. The inadvertent intruder analysis accounts for naturally occurring processes (e.g., erosion, precipitation, flooding) and the degradation of engineered barriers in the calculation of results. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.k.2.)

11c. The inadvertent intruder analysis calculates the maximum dose from disposed materials during the period of 100 -1000 years after site closure for waste acceptance criteria for wastes to be disposed of in the disposal facility using the recommendations of ICRP-30 (1979) and dose conversion factors from recognized published sources. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.k.3.)

Criterion 12. The results of the analyses for transport of radionuclides and the inadvertent intrusion into the disposal facility, and the sensitivity and uncertainty of the calculated results are comprehensive representations of the existing knowledge of the site and the disposal facility design and operations. (An illustration of the application of this criterion to evaluate whether a specific PA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.2.l.)

3.1.3 *Review Finding III - The PA Conclusions are Valid and Acceptable*

To declare that the PA conclusions are valid and acceptable, the Review Team must determine the following:

- The PA provides a reasonable expectation that the conclusions of the evaluation are valid, complete, and defensible, and the performance objectives of DOE Order 435.1 will be met.

- The conclusions incorporate the results, the uncertainties in the analysis, and the relevant site-specific issues to provide a valid projection of the operation and performance of the LLW facility.

- The results of the analysis accommodate the various uncertainties logically, allowing a valid basis for making a compliance decision.

- The analysis, results, and conclusions presented in the PA are sufficient for making a valid compliance decision.
- The performance objectives of DOE Order 435.1 are compared to the calculated results of the PA, the sensitivity and uncertainty analysis, the inadvertent intruder analysis, and the interpretations of these results and are presented in the conclusions.

The following acceptance criteria address this review finding that the conclusions of the PA are valid and acceptable.

Criterion 1. The PA presents valid conclusions that demonstrate that the all-pathways analysis, air pathway analysis, groundwater resource protection analysis, and inadvertent intruder analysis meet the performance objectives of DOE Order 435.1. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.a.)

1a. The all pathways performance objective of 25 mrem/year effective dose equivalent is met over the performance period of 1000 years for all radionuclides disposed of in the disposal facility. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.a.1.)

1b. The air pathways performance objective of 10 mrem/year effective dose equivalent is met over the performance period of 1000 years for all radionuclides disposed of in the disposal facility. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.a.2.)

1c. The radon performance objective of an average flux of 20 $pCi/m^2/s$ at the disposal surface or 0.5 pCi/L in air at the point of compliance is met over the performance period of 1000 years for all radionuclides disposed of in the disposal facility. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.a.3.)

1d. The groundwater resource performance measures for all radionuclides to be disposed of in the disposal facility are met over the performance period of 1000 years at the prescribed point of compliance. (An illustration of the application of this

criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.a.4.)

1e. The inadvertent intruder performance objectives of 100 mrem/year effective dose equivalent for chronic exposure and 500 mrem effective dose equivalent for acute exposure are met within the disposal facility over the performance period of 1000 years. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.a.5.)

1f. The condition that doses from the disposal of waste are ALARA has been demonstrated and incorporated into the design and operations of the disposal facility. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.a.6.)

Criterion 2. The PA conclusions incorporate the findings of the calculated results for the all pathways analysis, air pathway analysis, groundwater resource protection analysis, inadvertent intruder analysis, and sensitivity and uncertainty analysis. The results are interpreted and integrated to formulate conclusions which are supported by the results and the uncertainties in the results. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.b.)

Criterion 3. The conclusions of the PA are applied to the facility design and operations. The resulting design constraints and limitations on operations can be reasonably accomplished at the disposal facility. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.c.)

Criterion 4. The conclusions of the PA address and incorporate constraints included in Federal, state, and local statutes or regulations or agreements that impact the site design, facility design, or facility operations. The conclusions also address and incorporate any procedural or site documentation changes or constraints due to the results of the facility PA. Reasonable expectation exists that these constraints and impacts are appropriately addressed in the PA. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.d.)

Criterion 5. The analysis, results, and conclusions of the PA provide both a reasonable representation of the disposal facility's long-term performance and a reasonable expectation that the disposal facility will remain in compliance with DOE Order 435.1. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific PA are valid and acceptable is provided in Attachment 1, Appendix C, Table C-2, Criterion 3.1.3.e.)

3.2 CA Review Criteria

The Review Team must make the following fundamental conclusions, called review findings, regarding the CA:

- The CA is complete.
- The CA is thorough and technically supported.
- The CA conclusions are valid and acceptable.

Each of these review findings can be made using the acceptance criteria presented in the following sections. These acceptance criteria are intended to provide guidance but are not to be considered requirements to be satisfied in detail for every CA. Instead, the criteria should be addressed in the review commensurate with the importance of each criterion to the facilities being considered by the CA. Every CA will be limited by the amount of available data on the historical disposal facilities and other sources that could contribute to the potential offsite dose. Consequently, throughout the review of a CA, the emphasis of the review should be placed on understanding the estimates established in the analysis, and determining the likelihood that the estimates capture the consequences of LLW disposal considering all of the contributing sources included in the CA.

3.2.1 *Review Finding I - The CA is Complete*

To declare that the CA complete, the Review Team must determine the following:

- All material considered to be important in understanding the CA is presented so that a detailed CA review can be performed.

- The CA addresses each of the topics identified in the *Format and Content guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessment and Composite Analyses* and the discussion contains sufficient information for the review of the CA.

- The material presented in the CA is representative of current and available knowledge, does not overlook known information, and includes supporting information.

- The arguments and discussions included in the CA have technical merit and the conclusions represent reasonable interpretations of the results of the CA and are justified by the supporting data.

- The steps of the analysis follow logically one after another, and there are no extraneous discussions or unjustified assumptions.

- The methodology of analysis evaluates the important features of the other sources of radioactive material included in the CA, demonstrates an understanding of their relationship with the disposal facility, and is consistent with the analysis presented in the PA.

- The methodology of analysis is clearly explained and presented, and the results of the application of the methodology of analysis are clearly presented and interpreted to formulate the conclusions.

The following acceptance criteria address this review finding and provide the basis for identifying questions to be addressed, or requests for additional data or information concerning the disposal facility or the CA that are necessary to conduct a comprehensive review of the CA and to ensure the arguments presented in the CA are rational and logical.

Criterion 1. The CA includes a discussion of how the Data Quality Objectives (DQO) process was used as a flexible planning tool and applied to the CA preparation. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.a.)

Criterion 2. The CA identifies results, objectives, or milestones of other DOE programs, Federal, state, or local statutes, or agreements [e.g., Decontamination and Decommissioning (D&D) programs, Formerly Utilized Sites Remedial Action Program (FUSRAP), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and Records of Decision (RODs)] that may impact its analysis or conclusions. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.b.)

Criterion 3. The CA specifies and justifies the point of assessment for the disposal facility and all other contributing sources. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.c.)

3a. The point of assessment is the publicly accessible point of maximum impact reasonably expected for future members of the public for the time period of assessment. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.c.1.)

3b. The point of assessment selected is supported by land use plans or reasonably conservative assumptions that are justified. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.c.2.)

3c. Changes in the point of assessment as a function of time are justified. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.c.3.)

Criterion 4. The CA identifies all sources of radioactive material in the ground that could contribute to the potential future doses from the LLW disposal facility. Sources selected for the CA and the reasons for excluding any source are justified. Other potential sources of radioactive material to be considered include wastes disposed of prior to September 26, 1988, other LLW disposal facilities,

transuranic waste or alpha LLW disposals, buildings, tanks, cribs, spills, ditches, seepage basins, and leaks. Sources selected should include all sources that could make a significant contribution to potential future doses associated with the LLW disposal facility. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.d.)

Criterion 5. The CA identifies and quantifies all radionuclides present in the LLW disposal facility and all other contributing sources of radioactive material that could contribute significantly to the total potential dose. Inventory estimates included in the analysis are justified. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.e.)

5a. The estimates of radionuclide species and inventories in the sources selected for consideration are derived from referenced documentation or data summaries presented in the CA and are based on existing records, process knowledge, or site investigations (e.g., Remedial Investigations, Feasibility Studies). (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.e.1.)

5b. Extrapolations are made and justified from known data to estimate radionuclides and inventories where clear information does not exist. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.e.2.)

Criterion 6. The CA provides a reasonable methodology for estimating the release of radionuclides from the contributing sources selected for the CA based on available data. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.f.)

6a. The estimates of the release of radionuclides include the effects of CERCLA actions prescribed in RODs or similar binding agreements such as those associated with D&D. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.f.1.)

6b. The release mechanisms consider the physical and chemical characteristics of the source materials and the site characteristics. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.f.2.)

6c. Assumptions incorporated into the analysis are identified, justified, and consistent with the conceptual model of site behavior presented in the PA conducted on the LLW disposal facility. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.f.3.)

Criterion 7. The CA presents a reasonable methodology for estimating the transport of radionuclides to the point of assessment from all sources based on the available data for characterizing environmental behavior. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.g.)

7a. Mathematical modeling of the transport of radionuclides is commensurate with the available site data. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.g.1.)

7b. Assumptions incorporated into the mathematical models are identified, justified, and consistent with the conceptual model of site behavior presented in the PA conducted on the LLW disposal facility. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.g.2.)

7c. Mathematical models selected are documented and verified either in referenced publications or in the appendices of the CA. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.g.3.)

Criterion 8. The CA provides a complete discussion of all important exposure pathways for the evaluation of potential doses to a hypothetical, individual member of the public at the point of exposure for any time during the period of assessment. The exposure pathways identified in the CA should be consistent with the exposure pathways in the PA. The exposure pathways considered in the CA include only those pathways that are related to the exposure of individual members of the public at the point of assessment and are justified. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.h.)

Criterion 9. The CA provides a coherent presentation of the relevant descriptive information concerning the disposal site, its location on the DOE site, and its proximity to other sources of radioactive material. The sources of radioactive material are described along with the methodology for assessing the migration of radionuclides to the point of assessment, and the exposure scenarios following transport. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.i.)

Criterion 10. The CA presents an assessment using the time of 1000 years for exposures to hypothetical members of the public with all disposal facilities closed, decontamination and decommissioning completed, and operations at the DOE site terminated. The assessment establishes a "base case," that is a reasonably conservative, but realistic case for comparison with the dose limit and dose constraint. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.j.)

Criterion 11. The calculated results presented in the CA are consistent with the site characteristics, waste characteristics, and the conceptual model of the DOE site. The calculated results are consistent with available site monitoring data and any other data from supporting field investigations. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.k.)

Criterion 12. The sensitivity or uncertainty of the results is analyzed, including the consideration of alternative land uses and remedial actions. Uncertainties in radionuclide inventories for the disposal facility and other contributing sources are analyzed. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.l.)

Criterion 13. The calculated results of the sensitivity and uncertainty analyses are interpreted to evaluate meeting the dose constraint of 30 mrem/year and the dose limit of 100 mrem/year at the point of assessment throughout the period of assessment. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.m.)

Criterion 14. An options analysis is performed that identifies alternative actions which could be performed to reduce potential doses to a member of the public for results which exceed the dose constraint. The options analysis also identifies alternative actions which could be performed to reduce potential doses to a member of the public for results that exceed the dose limit. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.n.)

Criterion 15. The need for an ALARA assessment is presented based on the results of the CA and, if warranted, an assessment is performed to identify a need for actions to further reduce the doses calculated in the analysis. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.o.)

Criterion 16. The CA includes appendices or references to published documents that provide a basis for the discussions in the CA. (An illustration of the application of this criterion to evaluate whether a specific CA is complete is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.1.p.)

3.2.2 *Review Finding II - The CA is Thorough and Technically Supported*

To declare that the CA is thorough and technically supported, the Review Team must determine the following:

- The CA thoroughly examines the potential contribution of interacting source terms on the long-term performance of the disposal facility.

- The analysis addresses the important issues related to the disposal facility and other contributing sources to an extent commensurate with the data available and the significance of the source's contribution to the offsite dose.

- The analysis is representative of the available knowledge of site behavior and of available data on the interacting sources, and is a thorough representation of that knowledge.

- Sufficient depth of analysis, commensurate with the data available is presented in the estimates of radionuclide inventory, the conceptual models, the key assumptions incorporated into the models, the sensitivity or uncertainty analysis, and the options analysis to support the conclusions.

- The CA includes technically correct methodologies and calculations.

- The methodology of the analysis is justified and based on information and data about the potential contributing sources.

- Pathways and scenarios addressed in the analysis are justified, and are reasonable representations of the disposal facility and interacting source terms.

- The results determined are consistent with what would be expected based on the results of the PA of the LLW disposal facility and are representative of the disposal facility and the interacting source terms.

- The sensitivity or uncertainty of the calculated results are analyzed for the aspects of the assessment that may have a significant effect on the conclusions of the CA and the conclusions are supported, defensible, and justified.

The following acceptance criteria address this review finding. The criteria can be used to examine the thoroughness of the analysis and as the basis for requesting additional information to ensure the analysis is consistent with existing site information and that the conclusions are fully justified and defensible.

Criterion 1. The CA presents an estimate of the radionuclide inventory of the radioactive material considered in the analysis and justifies the estimate. This estimate is based on an examination of the waste disposal records, process knowledge, historical information related to the disposal facility and the contributing sources, and documents describing potential contributing sources of radioactive material such as Remedial Investigations and Feasibility Studies for cleanup actions, and other appropriate studies. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.a.)

> *1a.* All of the radionuclides anticipated to be present in wastes and in the contributing sources are considered in the CA. Radionuclides that are screened from the analysis are identified and their exclusion justified as being insignificant contributors to the total dose estimated in the analysis. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.a.1.)

1b. The known physical and chemical characteristics of the radioactive materials considered in the CA are included in the generation of the source terms and the transport of the radionuclides. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.a.2.)

Criterion 2. The conceptual model used for the CA is consistent with the representation of the conceptual model used in the PA, and includes the major mechanisms affecting the transport of radionuclides at the DOE site. The components of the conceptual model for the CA are reasonably represented in the analysis of the LLW disposal facility and other contributing sources. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.b.)

Criterion 3. Credits for CERCLA actions or other remedial actions are represented in the conceptual models used in the CA, and are justified by supporting or referenced documentation. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.c.)

Criterion 4. Source terms and flow and transport models in the CA are commensurate with the available data, incorporate the important characteristics identified in the PA, and provide results consistent with the PA. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.d.)

Criterion 5. The assumptions in the CA related to the radionuclides to be considered, to the inventories of radionuclides, the source term evaluation, and the transport of radionuclides are justified. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.e.)

Criterion 6. Any mathematical models used in the CA for analyzing the transport of radionuclides to the point of assessment are appropriate for the LLW disposal facility and all other contributing sources. The mathematical models used in the CA provide calculated results that are representative of the results calculated in the PA for similar wastes in similar disposal facilities. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.f.)

6a. The input data are based on field data from the site, laboratory data interpreted for field applications, referenced literature sources which are applicable to the site, or related analyses performed for the PA. Assumptions used to formulate input data are justified and have a defensible technical basis. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.f.1.)

6b. Intermediate calculations are performed, and the results are presented to demonstrate the CA calculations are representative of the site and are consistent with results presented in the PA for similar situations. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.f.2.)

Criterion 7. The dose analysis performed for the CA is consistent with that performed for the PA for similar exposure pathways and similar exposure scenarios. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.g.)

Criterion 8. The sensitivity and uncertainty analyses consider factors such as alternative land use plans, remedial actions, radionuclide inventories, site and facility characteristics, and transport parameters to provide reasonable estimates of potential doses at the point of assessment for the period of the assessment. The maximum projected dose over the period of the assessment (at least 1000 years) is presented at the point of assessment. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.h.)

Criterion 9. The need for an ALARA assessment as well as the ALARA assessment itself, is demonstrated using a cost-benefit analysis based on the cost of dose-reduction in the exposed population of $1,000 to $10,000 per person-rem averted. (ALARA assessments are not required if the projected individual or collective doses in the exposed population are trivial.) (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.i.)

Criterion 10. The options analysis considers alternatives which are technically feasible and demonstrated to be effective in reducing doses to the public at the point of assessment over the period of the assessment. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.j.)

Criterion 11. The results of the analysis for the source terms and transport of radionuclides, dose analysis, sensitivity or uncertainty analysis, and options analysis are reasonable representations of the existing knowledge of the site, disposal facility, and contributing sources. (An illustration of the application of this criterion to evaluate whether a specified CA is thorough and technically supported is provided in Attachment 1, Appendix C, Table C-1, Criterion 3.2.2.k.)

3.2.3 *Review Finding III - The CA Conclusions are Valid and Acceptable*

In order to declare the CA conclusions valid and acceptable, the Review Team must determine the following:

- The conclusions of the CA are complete and defensible with respect to the comparison of total projected dose from the LLW disposal facility and the contributing sources with the

dose constraint and the dose limit. For the conclusions to be defensible, the calculated results from the analysis are thorough, technically supported, and correctly interpreted with respect to the dose constraint and dose limit. For the conclusions to be complete, all uncertainties associated with the analysis are addressed and the potential for exceeding the dose constraint and dose limit evaluated.

- For facilities where the dose constraint or dose limit is exceeded, the options analysis and associated ALARA analysis identifies alternatives for reducing the dose to below the constraint.

- In evaluating the defensibility and completeness of the CA conclusions, their validity is established by determining that they provide a reasonable basis for allowing operation of the facility.

The following acceptance criteria address the review acceptability findings and are related to the validity of the conclusions of the CA as presented in the interpretation of results and the options analysis.

Criterion 1. The CA presents conclusions that demonstrate that the long-term performance of the disposal facility and other contributing sources is in accordance with the guidance in the *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.a.)

1a. For analyses that are less than the dose constraint of 30 mrem/year for the disposal facility and all other contributing sources, the need for an ALARA assessment is presented, and an ALARA assessment is performed if required. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.a.1.)

1b. For analyses that exceed the dose constraint but are less than the dose limit of 100 mrem/year, an options analysis is provided which identifies alternatives that could be conducted to reduce the dose to less than the dose constraint. The need for an ALARA assessment is presented, and an ALARA assessment is performed if required. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.a.2.)

1c. For analyses that exceed the dose limit of 100 mrem/year, an options analysis is provided which identifies alternatives that should be conducted to reduce the dose to less than the limit. The need for an ALARA assessment is presented, and an ALARA assessment is performed if required. (An illustration of the application of

this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.a.3.)

Criterion 2. The conclusions of the CA are derived from the interpretation of the calculated results for the LLW disposal facility and all contributing sources, the sensitivity or uncertainty analysis, and lead to the development of an options analysis if required. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.b.)

Criterion 3. The conclusions of the CA, presented in the interpretation of results and options analysis, can be reasonably accomplished at the disposal facility or implemented to affect the radionuclide contribution to dose from the other contributing sources. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.c.)

Criterion 4. The conclusions of the CA address and incorporate constraints resulting from other DOE programs or from Federal, state, and local statutes or regulations or agreements that would influence the calculated results or the options analysis. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.d.)

Criterion 5. The analysis, results, and conclusions of the CA provide a reasonable representation of the disposal facility and other contributing sources for determining the appropriate actions to be taken for the protection of public health and environment. The analysis and results of the CA are consistent with comparable results of the PA and provide a defensible and complete basis for an acceptable decision by DOE. (An illustration of the application of this criterion to evaluate whether the conclusions of a specific CA are valid and acceptable is provided in Attachment A, Appendix C, Table C-1, Criterion 3.2.3.e.)

4. DISPOSAL AUTHORIZATION STATEMENT

4.1 Introduction

4.1.1 Purpose

The DOE radioactive waste management order, DOE O 435.1, imposes a requirement that operating disposal facilities for low-level waste and for mixed low-level waste obtain a Disposal Authorization Statement. Facilities managed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) may use an approved record of decision as their Disposal Authorization Statement, provided that the requirements of 435.1 have been incorporated and met, as appropriate. Prior DOE policy and guidance also imposed similar conditions on operation of existing disposal facilities. This chapter describes the purpose, content, review and approval process, and references relevant to Disposal Authorization Statements and CERCLA Records of Decision used as Disposal Authorization Statements. For the remainder of this chapter, when the term low-level waste (LLW) is used, it is intended to include mixed low-level waste (MLLW) as well.

4.1.2 Disposal Authorization Requirement

The requirement that a Disposal Authorization Statement be obtained for DOE LLW disposal was introduced in the DOE Implementation Plan prepared in response to Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-2. It states that the PA and CA will be the basis for preparation of a Disposal Authorization Statement (p. VII-3) and notes that a CERCLA record of decision may be used as a Disposal Authorization Statement (p. VII-9). It also provides milestones for preparation of Disposal Authorization Statements for disposal facilities that were in operation or planned at that time. A key element of the Implementation Plan was to allow substitution of the CERCLA process for satisfaction of the substantive requirements of DOE radioactive waste management orders. The new DOE radioactive waste management order incorporates this alternative approach for facilities managed under the provisions of CERCLA.

The preparation and approval of a Disposal Authorization Statement was included in the new DOE Radioactive Waste Management Order and Manual 435.1. That requirement is consistent with the concept introduced in the Recommendation 94-2 Implementation Plan. The requirements specify that the Disposal Authorization Statement be issued based on review of the facility PA and CA and impose any necessary design or operation limits. The requirement in DOE Manual 435.1 also specifies that three additional facility documents be considered in approving a Disposal Authorization Statement: (1) the PA and CA Maintenance Plan; (2) Preliminary Closure Plan; and (3) the Preliminary Monitoring Plan.

4.1.3. Applicability

The requirement to obtain a Disposal Authorization Statement is applicable to DOE facilities that dispose of LLW and MLLW. Only facilities that are in operation or will operate in the future are subject to the Disposal Authorization Statement requirement. Disposal facilities that have operated in the past but will not be used for further disposal need not obtain a Disposal Authorization

Statement even if they have not undergone final closure. Disposal facilities under construction at the time of submission of the 94-2 Implementation Plan to the DNFSB (May 7, 1996) are required to obtain a Disposal Authorization Statement prior to beginning operation. Disposal facilities that are planned must obtain a Disposal Authorization Statement prior to construction.

Facilities that were operating prior to approval of the 94-2 Implementation Plan are permitted to continue operating, but must ultimately obtain a Disposal Authorization Statement or face shutdown. The Disposal Authorization Statements for these facilities are to be completed and approved on a schedule established by DOE with DNFSB agreement. If the facility is now used or is to be used for on-site disposal of LLW generated by on-site environmental restoration under CERCLA, the Record of Decision (see section 3.1.5 below for details) for the CERCLA clean-up can serve as the Disposal Authorization Statement.

4.1.4 Responsibility

The principal organization within DOE that is responsible for designing, constructing, operating, and closing LLW disposal facilities is the Office of Environmental Management. Under the anticipated EM reorganization plan (Fall 1999), the Deputy Assistant Secretary for Site Closure and the Deputy Assistant Secretary for Project Completion will be responsible for all of the EM disposal facilities. Some of the EM disposal facilities are intended primarily for on-site disposal of LLW from CERCLA activities, while the other disposal facilities are expected to receive a much broader range of waste generators.

The Deputy Assistant Secretaries are responsible for approving Disposal Authorization Statements for each CERCLA and non-CERCLA facility at sites under their direction. Both Deputy Assistant Secretaries are responsible for non-CERCLA disposal facilities and at least one CERCLA disposal facility. The Record of Decision for a CERCLA facility may be designated by the cognizant Deputy Assistant Secretary to additionally serve as the Disposal Authorization Statement, provided that the requirements of 435.1 have been incorporated and met, as appropriate.

4.1.5 Adaptation of Disposal Authorization for CERCLA Facilities

The Department recognizes that although their activities are subject to the provisions of the Atomic Energy Act of 1954, as amended, some Departmental LLW disposal activities must also comply with the provisions of CERCLA. The Department has sought to reduce duplication of effort that could result from independently satisfying the requirements of both of these statutes and their implementing regulations and other requirements. The potential duplication of effort is addressed in DOE Manual 435.1 by allowing for demonstration of compliance with the substantive requirements of DOE Orders using CERCLA activities. DOE Manual 435.1 specifies that a crosswalk identifying the CERCLA activities that satisfy the substantive DOE requirements, eliminates the need for separate compliance actions. This provision of DOE Manual 435.1 is a formalization of the DOE *Policy for Demonstrating Compliance with DOE Order 5820.2A for Onsite Management and Disposal of Environmental Restoration Low-Level Wastes under the Comprehensive Environmental Response, Compensation, and Liability Act* which was approved and submitted to the DNFSB on May 31, 1996. A companion policy was subsequently prepared by the

Department to address similar potential duplication of effort in applying the Resource Conservation and Recovery Act and applicable state regulations to environmental restoration activities. These policies are reflected in the new DOE Order 435.1, *Radioactive Waste Management*.

The essence of the DOE Manual 435.1 requirement is that for environmental restoration activities for which LLW is managed and disposed on-site pursuant to CERCLA, any substantive requirement of DOE Order 435.1 that has been complied with pursuant to a requirement of CERCLA need not be applied separately. The guidance for the requirement directs that, to the extent practical, the substantive requirements of the order should be directly incorporated into the CERCLA process.

The guidance for this requirement includes an enumeration of three key benefits:

- It avoids duplication of effort (i.e., the CERCLA process can be used to satisfy the requirements of DOE Order 435.1);

- It eases EPA and State concerns about the overlap of CERCLA regulations and the Department requirements; and

- It enables the Department to better achieve its goals of ensuring managerial and financial control and fulfilling enforceable milestones.

These benefits continue with the implementation of DOE O 435.1 on radioactive waste management because of the incorporation of the provisions of the CERCLA Policy in the LLW requirements of the order. DOE O 435.1 also establishes a certain date for completion and approval of the required disposal authorizations. The guidance for the revised order provides detailed information, consistent with this document, on implementation of the requirements for LLW disposal facilities managed under the provisions of CERCLA.

For the remainder of this chapter, the term Disposal Authorization Statement will be used to encompass the option for disposal facilities to use a CERCLA record of decision to document authorization for disposal rather than prepare a separate Disposal Authorization Statement.

4.1.6 Failure to Obtain a Disposal Authorization

The 94-2 Implementation Plan provides that if the PA and CA do not support issuance of a Disposal Authorization Statement, action must be taken by the host site to resolve the concerns and issues prior to continuing or initiating operation. Furthermore, the disposal authorization requirement in the DOE Manual 435.1 states that failure to obtain a Disposal Authorization Statement for an existing facility by the implementation date of the order (October 1, 2000) may result in shutdown of that facility. Planned disposal facilities must obtain a Disposal Authorization Statement prior to construction.

4.2 Purpose of the Disposal Authorization

4.2.1 Facility-Specific Conditions

The Disposal Authorization Statement verifies that the required radiological assessments have been performed and that they support the conclusion that the low-level waste disposal performance objectives will be satisfied. It also documents limits on design, construction, operations and closure for the subject disposal facility. The limits and conditions are to reflect the findings and conclusions of the PA and the CA. Approval of a Disposal Authorization Statement is also based on review of three additional facility-specific documents: 1) the performance assessment and composite analysis maintenance plan; 2) the preliminary closure plan; and 3) the preliminary monitoring plan.

4.2.2 Radioactive Waste Management Basis

The DOE O 435.1 introduces a concept for waste management that is familiar to DOE facility managers—the basis for operation. In the waste management context, this concept is referred to as the Radioactive Waste Management Basis and consists of the physical and administrative controls to ensure the protection of workers, the public, and the environment. The disposal authorization provides the written record of the conditions on design, construction, operation, and closure of a LLW disposal facility required for the radioactive waste management basis. DOE M 435.1 identifies the documents that comprise the radioactive waste management basis for LLW disposal facilities:

- Disposal Authorization Statement;
- Performance Assessment;
- Composite Analysis;
- Closure Plan;
- Waste Acceptance Requirements; and
- Monitoring Plan.

Therefore, a key purpose of the disposal authorization under DOE O 435.1 is to provide part of the radioactive waste management basis for LLW disposal facilities.

4.2.3 Final Approval for Disposal

The granting of a disposal authorization is the final requirement that must be satisfied for approved disposal of DOE LLW. Preparation and approval of a disposal authorization relies on the findings and conclusions of the assessments and analyses that are designed to demonstrate that a disposal facility will not threaten the health or safety of humans or harm the environment.

4.3 Prerequisites to Disposal Authorization

The preparation and approval of a Disposal Authorization Statement is the last of a series of steps that provide the foundation for the Disposal Authorization Statement. This section describes the actions and any tangible results of those actions that must precede preparation and consideration for approval of a draft Disposal Authorization Statement. These precursors to disposal authorization are included in the flowcharts (Figures 4-1, 4-2, and 4-3) illustrating the various processes that may be used to obtain a Disposal Authorization Statement.

4.3.1 Completed Documents

Low-level waste disposal facilities managed under the requirements of DOE radioactive waste management orders are required to have the following final documents:

1. PA prepared by the disposal site;

2. CA prepared by the disposal site;

3. PA Review Report prepared by a Review Team appointed by the LFRG;

4. CA Review Report prepared by a Review Team appointed by the LFRG (may be combined with Item 3);

5. PA Compliance Evaluation prepared by the LFRG;

6. CA Compliance Evaluation prepared by the LFRG (may be combined with Item 5); and

7. Performance Assessment and Compliance Evaluation Maintenance Plan prepared by the disposal site.

Low-level waste disposal facilities managed under the provisions of CERCLA are required to have the following final documents:

1. Written certification by the cognizant Field Element Manager (or his designee) that substantive requirements of the DOE Manual 435.1 have been satisfied through the CERCLA process.

2. A crosswalk or other written material linking specific elements of the CERCLA documentation to the substantive order requirements that they satisfy.

3. Documentation, analyses, or other information on compliance for any substantive order requirement for which compliance is not demonstrated through the CERCLA process. Included among this documentation may be a CA, provided the CERCLA analysis of interacting source terms is not of sufficient scope and rigor to satisfy the DOE order requirement for a CA.

4.3.2 Preliminary Documents

The development of certain documents will necessitate an iterative process and final versions of them cannot reasonably be required as prerequisites to granting disposal authorization. Therefore, only preliminary versions of such documents must be prepared prior to granting disposal authorization. However, subsequent timely revision of these documents may be included as a condition of the approved Disposal Authorization Statement. The documents are the following:

1. Preliminary Monitoring Plan
2. Preliminary Closure Plan

4.3.3 Reviewed Documents

Several of the required documents listed in Section 4.3.1 above, are products of the review of other documents. The reviews on which those documents are based must be performed according to the requirements of DOE policy and orders. Guidance on the review process and criteria is detailed in other documentation supporting oversight of LLW disposal facilities. For example, the process and criteria for review of PAs and CAs are described at length in Chapter 2 of this manual. The documents that must be reviewed for facilities managed under the requirements of DOE O 435.1 and the primary parties responsible for the review, are the following:

- Performance Assessment – reviewed by the LFRG Review Team
- Composite Analysis – reviewed by the LFRG Review Team
- Performance Assessment Review Report – reviewed by the LFRG
- Composite Analysis Review Report – reviewed by the LFRG
- Performance Assessment Compliance Evaluation – reviewed by the cognizant Deputy Assistant Secretary
- Composite Analysis Compliance Evaluation – reviewed by the cognizant Deputy Assistant Secretary
- Disposal Authorization – reviewed by the cognizant Deputy Assistant Secretary

In addition to the primary review parties, other interested and affected parties will be offered opportunities to review documents. Host site personnel will have a stake in reviews of all of the cited documents. However, the purpose of and response to the reviews by non-primary parties will vary. For example, review and comment by the host site of the LFRG Review Team reports, has bearing on their factual content, but is not relevant in disputing the opinions and views expressed by the LFRG Review Team.

4.3.4 Actions

Actions that must be completed prior to drafting and submitting the disposal authorization to the cognizant Deputy Assistant Secretary are the following:

1. Approval by the cognizant Deputy Assistant Secretary of the PA for a facility managed under the requirements of DOE O 435.1.

2. Approval by the cognizant Deputy Assistant Secretary of the CA for a facility managed under the requirements of DOE O 435.1.

3. Review by the cognizant Deputy Assistant Secretary of appropriate CERCLA documentation for a facility managed under the requirements of CERCLA. In this context, the term "appropriate CERCLA documentation" means the written materials prepared to demonstrate compliance with the substantive low-level disposal requirements of DOE O 435.1. Specifically included in such written materials are crosswalks between CERCLA requirements and DOE O 435.1 requirements which are used as the basis for issuance of a disposal authorization by the cognizant Deputy Assistant Secretary.

4. Approval by the cognizant Deputy Assistant Secretary of any additional material demonstrating compliance with substantive requirements not met through the CERCLA process. For example, if the CERCLA process for evaluation of interacting sources does not satisfy the DOE requirement for a CA, then a separate CA must be prepared and approved by the cognizant Deputy Assistant Secretary.

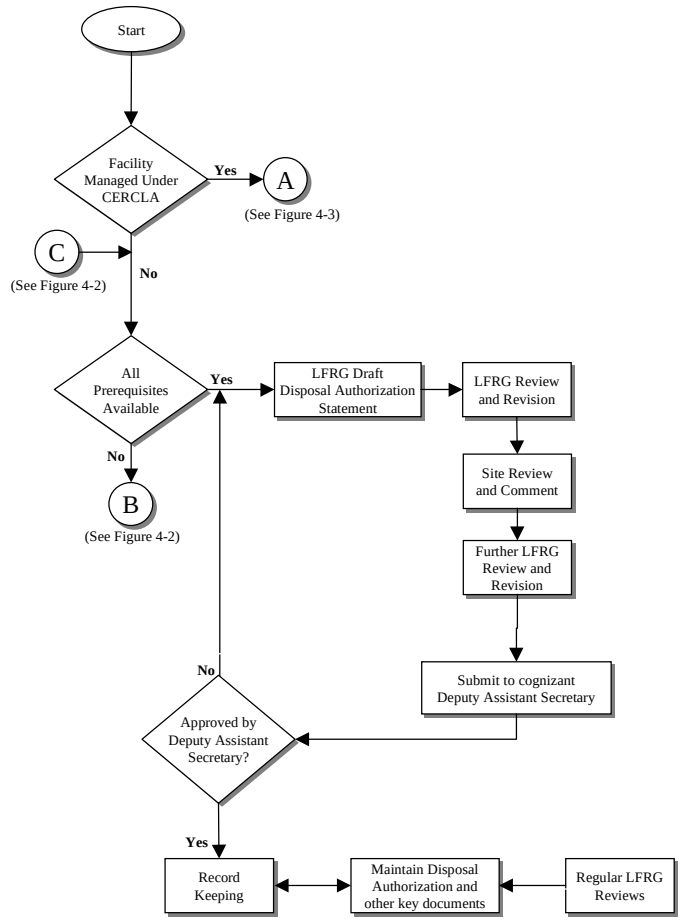
4.4 Preparation

The following description uses the base case for the development of the Disposal Authorization Statement. A disposal facility that is managed under the requirements of DOE O 435.1 will have a PA and CA completed and approved at the time of preparation of the Disposal Authorization Statement. The process for that base case is illustrated in Figure 4-1. A variation of the base case also described in this section is the case of step-wise approval of the PA and CA with interim operation of the disposal facility. That case is described by the flowchart in Figure 4-2. Another variation described is the use of the CERCLA process to demonstrate compliance with DOE radioactive waste management requirements and the use of a CERCLA record of decision or a disposal authorization to document the final approval for disposal. That case is described in Figure 4-3.

4.4.1 Drafted by the Low-Level Waste Disposal Facility Federal Review Group

The disposal authorization is based on the PA and CA. Thus, it cannot be prepared until those documents are reviewed and approved. Three other documents that also need to be prepared and reviewed prior to drafting a Disposal Authorization Statement are (1) the Preliminary Monitoring Plan, (2) the Preliminary Closure Plan, and (3) the PA/CA Maintenance Plan. Furthermore, a waste characterization program and a waste certification program must be in place. Upon completion of these actions, the Disposal Authorization Statement is to be prepared by the LFRG for consideration by the cognizant Deputy Assistant Secretary.

Figure 4-1. Disposal Authorization Statement Preparation Process for LLW Disposal Facilities Managed Under DOE Orders
(The prerequisites for a disposal authorization statement are presented in Table 4-1)



4.4.2 Guidance for Draft Preparation

The final Disposal Authorization Statement is not issued by the cognizant Deputy Assistant Secretary until both the PA and the CA have been approved and all conditions necessary for the disposal facility to follow as a result of both analyses have been determined. However, the timing of submittals of PAs and CAs from some DOE sites to Headquarters for review is complicated by the fact that some PAs have been completed and reviewed already, while CA reviews are just beginning. This could result in the completion of LFRG activities on some PAs in advance of those concerning the CA for the same facility.

Table 4-1. Prerequisites for a Disposal Authorization Statement

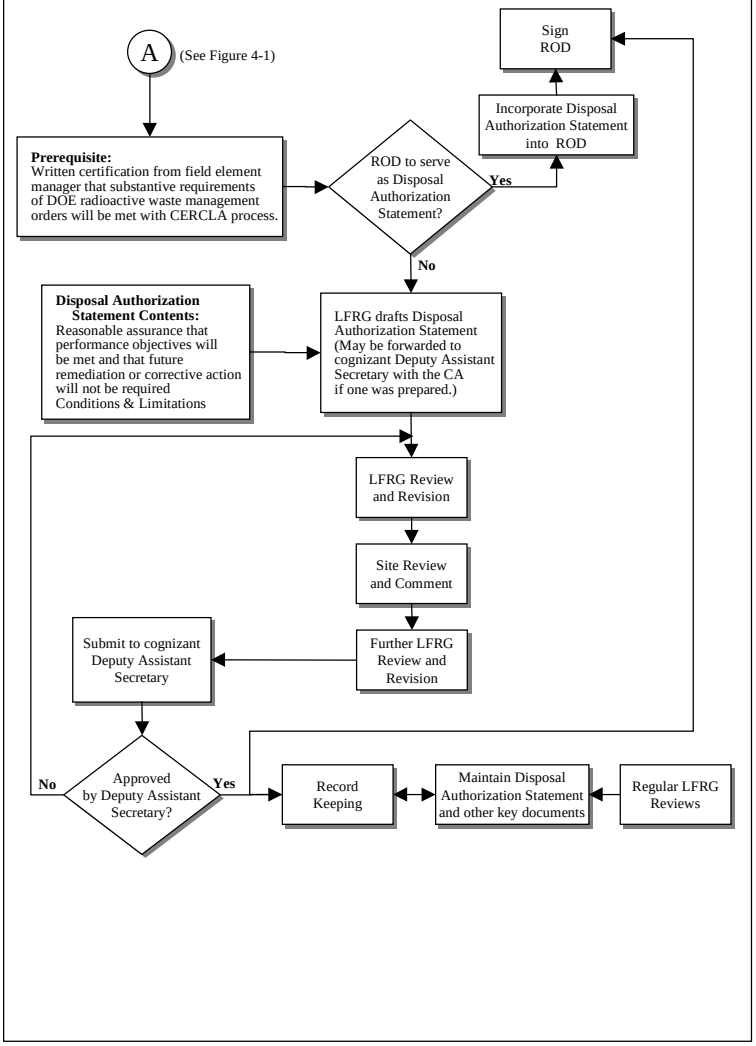
Interim Disposal Authorization Statement	Final Disposal Authorization Statement
Performance Assessment (PA) PA Review Report PA Compliance Evaluation Preliminary Monitoring Plan Preliminary Closure Plan	Performance Assessment PA Review Report PA Compliance Evaluation PA Maintenance Plan Preliminary Monitoring Plan Preliminary Closure Plan Composite Analysis (CA) CA Review Report CA Compliance Evaluation CA Maintenance Plan
NOTE: Corresponding Performance Assessment and Composite Analysis documents can be combined. For example, the PA Maintenance Plan and the CA Maintenance Plan can be combined into a single PA/CA Maintenance Plan.	

If this occurs, the LFRG should modify the process to accommodate this event. A suggested approach is to develop the PA Compliance Evaluation for the disposal facility, conditionally approving the PA and allowing operations to continue. One condition of allowing operations to continue would specify the time of submittal of the final CA by the site. Conditions on the operation of the facility, until the CA is completed, should also be considered, such as limitations of acceptance of radionuclides that may be potentially critical radiation dose contributors in the CA.

The draft Disposal Authorization Statement should be prepared following the completion of the review and approval of both the PA and the CA. In this case, documentation on the facility accompanying the Disposal Authorization Statement, prepared by the LFRG, could include two Compliance Evaluations, one for the PA and one for the CA. The conditions in the draft Disposal Authorization Statement would be an

Figure 4-3. Disposal Authorization Statement Preparation Process for LLW Disposal Facilities Managed Under CERCLA

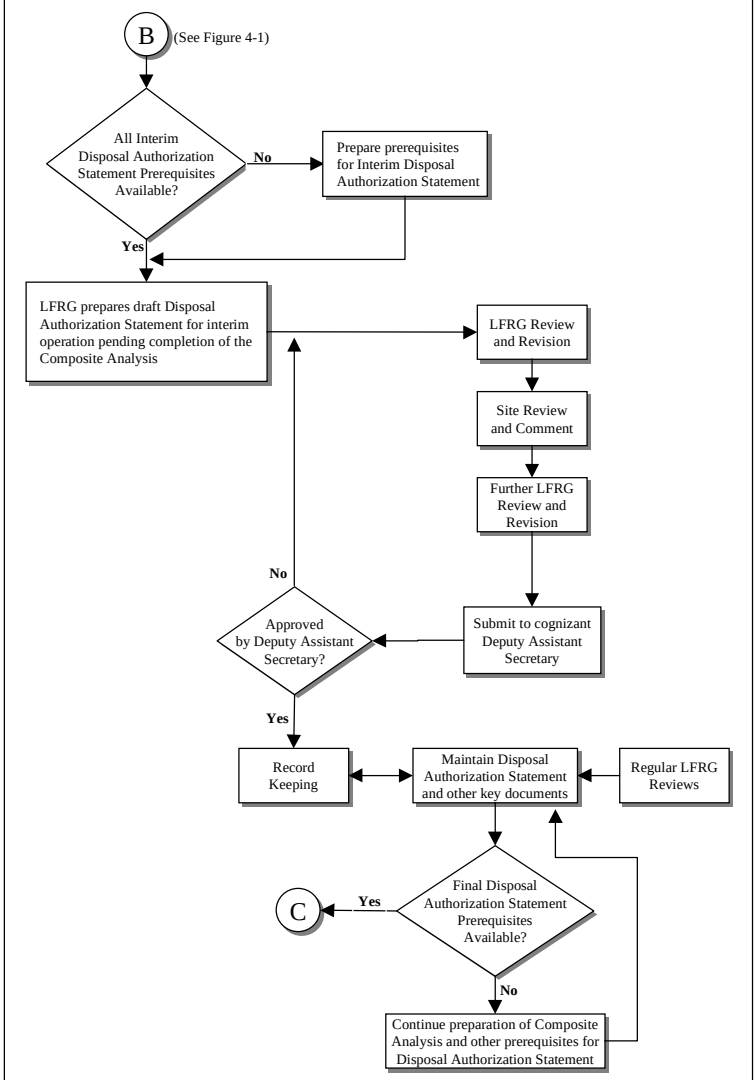
(Assumption: Only EM-40 will use CERCLA for LLW Disposal.)



appropriate consolidation of discussions from the two Compliance Evaluations.

Primary direction to the LFRG for preparation of the Disposal Authorization Statement is provided by the cognizant Deputy Assistant Secretary in consultation with other Deputy Assistant Secretaries and the Environment, Safety and Health Office of Environmental Policy and Assistance (EH–41). The LFRG may in turn request the assistance of the Review Team leader, if one was appointed to lead a Review Team in reviewing the facility's PA and/or CA.

Figure 4-2. Disposal Authorization Statement Preparation Process for Interim Operations Pending Completion of All Prerequisites



4.4.3 CERCLA Facilities Process

For facilities that are managed under the CERCLA process, a key document is the record of decision. If the managers of such facilities choose to demonstrate compliance with the substantive requirements of DOE O 435.1 via the CERCLA process and its results, then the record of decision for the environmental restoration activity may be used to satisfy the Disposal Authorization Statement requirement. Figure 4-3 illustrates the process for facilities managed under CERCLA. The record of decision should include the information that would otherwise be included in the Disposal Authorization Statement. Note that when the CERCLA process is used, compliance with the administrative requirements of the DOE radioactive waste management order need not be demonstrated.

4.4.4 Disposal Authorization Contents

Satisfaction of Performance Objectives

The disposal authorization should unambiguously identify the facility and the design that is being authorized for operation. For example, if the PA and its conclusions are based on the use of an engineered barrier (e.g., concrete vault), the disposal authorization should clearly indicate that the

authorization is for disposal in that type of facility and variations (e.g., trench disposal) are not covered by the PA and the disposal authorization.

The highest level element of the required disposal authorization is a declaration that analyses and documentation for the subject facility provide a reasonable expectation that the performance objectives described in the DOE radioactive waste management order will be satisfied. A related high level element of the required authorization is a declaration that the facility will not require subsequent corrective action or remedial action in order to continue to satisfy the performance objectives.

Facility-Specific Conditions

Items that are to be recorded in the disposal authorization include all conditions and limitations imposed on the facility in the areas of design, construction, operations, and closure, and on maintenance of the analysis which supports authorization of the facility. Specific conditions and limitations should be considered for waste acceptance and receipt, waste form, monitoring, and record keeping. Documents that must be maintained (i.e., kept up-to-date) include the PA, CA, Disposal Authorization Statement, monitoring plan, maintenance plan, and the closure plan. Specific conditions requiring the conduct of certain monitoring, testing, or research may be invoked if deemed necessary to confirm parameter selection or assumptions on facility performance presented in the PA.

Facility-specific conditions may be derived through the results of the PA and the CA. To facilitate the preparation of the Disposal Authorization Statement, the staff should examine the PA and CA for detailed explanations of how the results of the analyses were used to derive radionuclide limits. In addition to constraining the site to those limits derived from the PA and/or CA, a condition may be imposed that requires that additional limitations on receipt or method of disposal of certain radionuclides be incorporated into site operating documents.

List of Permits, Licenses, and Other Authorizations

The Disposal Authorization Statement must include a list of all permits, licenses, and authorizations required by applicable federal and state statutes and their implementing regulations and requirements. For each such permit, license, and authorization, the disposal authorization is to also state the date granted, the duration, the granting party, and a citation that will allow reliable access to the original or a current copy of final documentation.

4.4.5 Disposal Authorization Review

The draft Disposal Authorization Statement may be prepared by one or more members of the LFRG or its support staff including the Review Team leader if a Review Team was established to review the PA and/or CA for the facility. Upon completion of the draft, it will be submitted for review and comment to the LFRG members and any Review Team leaders for the facility. Appropriate revisions will be performed and the revised draft will be submitted to the host site for review. Following

incorporation of site comments, as appropriate, the final draft disposal authorization will be submitted to the cognizant Deputy Assistant Secretary for consideration.

4.4.6 Grantor of Final Approval

The disposal authorization will be approved or disapproved by the cognizant Deputy Assistant Secretary.

4.5 Follow-Up Activities

Successful maintenance of the key documents describing expected performance of DOE LLW disposal facilities depends on three elements: (1) reviews and revisions of the PA and CA, (2) monitoring, and (3) test and research activities related to the PA and CA. This section describes the requirements that support successful maintenance of the key documents and, in particular, the disposal authorization.

4.5.1 Regular Compliance Reviews

The principal source of guidance for maintenance of key documentation supporting operation of DOE LLW disposal facilities is the *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*. This document specifies annual reviews of the continued adequacy of the PA for each DOE LLW disposal facility. Any changes to the PA necessitated by the annual reviews should be evaluated to determine if conforming changes to the disposal authorization are needed. A similar requirement for annual review of LLW disposal facility operations is included in DOE O 435.1, and a condition may be added to the disposal authorization that certain reviews be performed on a schedule other than the annual schedule.

In addition to the annual reviews, intermittent reviews may also be performed at the discretion of the LFRG or other DOE Headquarters organizations with responsibilities for line management or independent oversight of DOE LLW disposal facilities.

4.5.2 Monitoring

The monitoring and actual performance of a disposal facility can provide data that will confirm or refute the expected performance of a disposal facility. In addition to direct release data, monitoring can also provide refined parameters such as soil permeability and groundwater travel time required for performance models. Any such refined data should be used to update the modeling of performance and to determine whether changes are needed in key analyses such as the PA and CA. Necessary changes in those documents should be accompanied by conforming changes in the disposal authorization and may include changes in or additions to the conditions included in the disposal authorization for design, construction, operations, and closure of the facility.

4.5.3 Research and Development

In addition to facility-specific data-gathering and refinement, research and development in waste disposal facility design, construction, operations, and closure can precipitate the need for revision of key documentation including the Disposal Authorization Statement.

4.6 Records Management

The record keeping practices for DOE LLW disposal facilities are to comply with the requirements of DOE O 200.1, Information Management Programs, and DOE O 5700.6C, Quality Assurance. For DOE LLW disposal facilities managed under the requirements of CERCLA, the records management requirement of the CERCLA process will apply as well as following more specific guidance.

4.6.1 Records Retained

For a facility managed under DOE radioactive waste management requirements, the following are the minimum suite of documents that must be retained and kept up-to-date for each such facility.

(1) Performance Assessment
(2) Composite Analysis
(3) Performance Assessment Review Plan
(4) Composite Analysis Review Plan
(5) Performance Assessment Review Report
(6) Composite Analysis Review Report
(7) Performance Assessment Compliance Evaluation
(8) Composite Analysis Compliance Evaluation
(9) Disposal Authorization

For a DOE LLW disposal facility managed under the provisions of CERCLA, any of the documents above that are prepared for the facility must be retained. In addition, if the facility record of decision serves as the written disposal authorization, it must be retained as well as the crosswalk or documentation that demonstrates which actions and documentation of the CERCLA process indicate compliance with the substantive requirements of DOE radioactive waste management manual 435.1.

4.6.2 Responsible Organizations

Generally, the organization responsible for generation of each of the documents above is to retain the original and other key organizations are to retain copies to provide easier access and to promote preservation of a complete record for the facility. The following specifies the organization responsible for retention of the original copies of the key documents. The organization responsible for retaining each original is also responsible for distributing revisions to the other record retention organizations.

(1) Performance Assessment – Disposal Facility
(2) Composite Analysis – Disposal Facility
(3) Performance Assessment Review Plan – LFRG
(4) Composite Analysis Review Plan – LFRG
(5) Performance Assessment Review Report – LFRG
(6) Composite Analysis Review Report – LFRG
(7) Performance Assessment Compliance Evaluation – LFRG
(8) Composite Analysis Compliance Evaluation – LFRG
(9) Disposal Authorization Statement – Disposal Facility

In addition to the LFRG and disposal facility files, a complete set of copies of these documents will be maintained by the Center of Excellence for Low-Level Waste Management.

4.7 Preparation Schedule

A schedule for completion and approval of the Disposal Authorization Statements (or the CERCLA alternative) is provided in the 94-2 Implementation Plan. A corresponding provision in DOE O 435.1, the requirement for a complex-wide low-level waste management plan, contains a schedule to be followed for preparation of disposal authorizations for disposal facilities that do not already possess one.

Appendix A - LFRG Charter

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CHARTER

OFFICE OF ENVIRONMENTAL MANAGEMENT
LOW-LEVEL WASTE FEDERAL REVIEW GROUP

I. Mission

The Office of Environmental Management (EM) Low-Level Waste Federal Review Group (LFRG) was established to fulfill the requirements contained in Section I.2.E(1)(a) of DOE Order 435.1 and exercised by the upper-level managers of the Office of Environmental Management (EM). The LFRG assists upper-level EM managers in the review of documentation related to the approval of PAs and CAs or appropriate Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documentation as described in Section II of this charter. Through its efforts, the LFRG supports the issuance of Disposal Authorization Statements for low-level radioactive waste disposal. The LFRG also assists in other duties associated with low-level waste (LLW) disposal authorizations as assigned by upper-level EM managers.

II. Objectives

Through the establishment and implementation of the LFRG process, the Department evaluates operational suitability of DOE disposal facilities through compliance with DOE LLW disposal requirements. The LFRG process supports the self-regulation responsibility imposed on the Department of Energy (DOE) under the Atomic Energy Act of 1954 as amended.

The specific objectives of the LFRG are:

- Track the preparation and completion status of documents prepared to demonstrate compliance with DOE LLW disposal requirements and report this information to upper-level EM managers;

- Develop and conduct a formal review process that documents an auditable analysis and review of key documents and provides for creation and maintenance of the administrative record of the LFRG and its actions;
- Review documentation submitted by LLW disposal facility host sites and support the process of granting Disposal Authorization Statements;

- Provide the cognizant upper-level EM managers with approval recommendations that represent the decisions of the LFRG membership;

- Prepare Disposal Authorization Statements, with conditions when justified, for DOE LLW disposal facilities; and

- Conduct reviews and assessments as directed by upper-level EM managers and provide recommendations.

The key documents, utilized to support development and approval of Disposal Authorization Statements for DOE LLW disposal facilities, consist of one of two document sets: (1) an approved PA and CA; or (2) appropriate CERCLA documentation that demonstrates compliance with the substantive requirements of DOE Order 435.1. Demonstration of compliance through the appropriate CERCLA documentation shall be summarized with a crosswalk that identifies each DOE LLW requirement satisfied by CERCLA. Substantive DOE LLW requirements unsatisfied by CERCLA are to be complied with separately. The LFRG is responsible for the determination of the adequacy of CERCLA documentation and for demonstrating compliance with DOE LLW requirements.

Based upon the review of either document set, a Disposal Authorization Statement is prepared by the LFRG for consideration by the cognizant upper-level EM manager. Upon approval, the Disposal Authorization Statement is signed by the cognizant upper-level EM manager.

III. Organization

The Co-Chairs of the LFRG are appointed by upper-level EM managers from among their staffs. The Co-Chairs are responsible for establishing and maintaining LFRG membership and establishing operating procedures, conducting meetings, and communicating results of LFRG deliberations to affected sites and to upper-level EM managers. Procedures, responsibilities, schedules, and other appropriate information for organization and operation of the LFRG will be documented in the LFRG Program Management Plan.

Members of the LFRG are recruited by the Co-Chairs in consultation with upper-level EM managers. The membership of the LFRG shall consist of Federal employees from Headquarters and field organizations. A representative from the DOE Office of Environment, Safety and Health (EH) shall serve on the LFRG to provide environment, safety, and health technical expertise. Members of the LFRG are expected to be competent in the technical evaluation of the documentation to be reviewed by the LFRG, to possess expertise in policy analysis, and to hold positions that authorize them to act on behalf of their respective organizations. The members of the LFRG are responsible for participation in the meetings of the LFRG and other activities as directed by the Co-Chairs. Continued membership on the LFRG is dependent upon adequate participation and timely review of documentation as determined by the Co-Chairs. Members of the LFRG shall serve until replaced or removed by the Co-Chairs.

A Review Team is established for each specific site review. A Review Team leader is selected by the LFRG Co-Chairs in consultation with the LFRG members and must be a Federal employee. The Review Team leader selects the balance of Review Team members with the concurrence of the Co-Chairs. Review Team members are selected based on their qualifications for addressing key elements of the documentation to be reviewed. One or more of the Review Team members will be an LFRG member.

IV. Quorum and Voting

The desired quorum for deliberations by the full LFRG is a majority of the current membership (which includes the Co-Chairs). The LFRG Co-Chairs seek a consensus on the decisions of the LFRG. Ultimately, decisions are approved by affirmative vote of a simple majority of the LFRG members and Co-Chairs. Minority reports may be appended to records of LFRG decisions at the request of any member or Co-Chair. Only LFRG members have voting rights. These rights may not be delegated to individuals participating in LFRG activities as representatives of the members.

In instances when a majority cannot be achieved, the LFRG Co-Chairs may jointly act on behalf of the LFRG. Decisions made solely by the Co-Chairs on behalf of the majority must be documented in writing and noted as having been made by the Co-Chairs rather than by majority.

V. Authorizations

Mark W. Frei
Acting Deputy Assistant Secretary for
Waste Management

James J. Fiore
Acting Deputy Assistant Secretary for
Environmental Management

VI. Concurrences

Jay Rhoderick
LFRG Co-Chair

William E. Murphie
LFRG Co-Chair

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Appendix B - Definitions

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Appendix B - Definitions

ACUTE EXPOSURE SCENARIOS. Acute exposure scenarios are hypothetical situations developed for the purpose of forecasting the radiation doses that inadvertent intruders could receive due to a short-term, high-intensity exposure to waste from a closed disposal facility.

ALPHA LOW-LEVEL WASTE. Alpha low-level waste is low-level waste that contains transuranic radionuclides in concentrations over 10 nanocuries per gram but less than 100 nanocuries per gram. (Waste in which the concentration of transuranic radionuclides is greater than 100 nanocuries per gram is generally classified as transuranic waste.)2

CHRONIC EXPOSURE SCENARIOS. Chronic exposure scenarios are hypothetical situations developed for the purpose of forecasting the radiation doses that inadvertent intruders could receive due to long-term, relatively low exposures to waste from a closed disposal facility.

CLOSURE. Deactivation and stabilization of a radioactive waste facility intended for long-term confinement of waste. [DOE Manual 435.1]

COGNIZANT DEPUTY ASSISTANT SECRETARY. For a low-level waste disposal facility, the cognizant deputy assistant secretary is the one to whom operators of the facility ultimately report through normal line management chains.

COMPLIANCE EVALUATION. A compliance evaluation is a written evaluation prepared by the Low-Level Waste Federal Review Group to document the acceptability of a performance assessment, a composite analysis, or both for a specific disposal facility.

COMPOSITE ANALYSIS. An analysis that accounts for all sources of radioactive material that may contribute to the long-term dose projected to a hypothetical member of the public from an active or planned low-level waste disposal facility. The analysis is a planning tool intended to provide a reasonable expectation that current low-level waste disposal activities will not result in the need for future corrective or remedial actions to ensure protection of the public and the environment. [DOE Manual 435.1]

DISPOSAL. Emplacement of waste in a manner that ensures protection of the public, workers, and the environment with no intent of retrieval and that requires deliberate action to regain access to the waste. [DOE Manual 435.1]

DISPOSAL AUTHORIZATION STATEMENT. Documentation authorizing operation (or continued operation) of a low-level waste disposal facility resulting from the DOE Headquarters review and acceptance of the facility's performance assessment, composite analysis, and other information and evaluations. The disposal authorization statement constitutes approval of the performance assessment and composite analysis, authorizes operation of the facility, and includes conditions the disposal facility must meet. {DOE Manual 435.1]

LOW-LEVEL WASTE. Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, spent fuel, transuranic waste, byproduct material (as defined in Section 11.e(2) of the *Atomic Energy Act of 1954*, as amended), or naturally occurring radioactive material. [DOE Manual 435.1]

LOW-LEVEL WASTE FEDERAL REVIEW GROUP. The Low-Level Waste Federal Review Group was chartered by the two Deputy Assistant Secretaries in the DOE Office of Environmental Management who have principal line management responsibility for DOE low-level waste disposal facilities. Its primary purpose is to assist those Deputy Assistant Secretaries in reviewing assessments and analyses of low-level waste disposal facilities and making recommendations on their acceptability.

MIXED LOW-LEVEL WASTE. Low-level waste that contains both source, special nuclear or by-product material subject to the *Atomic Energy Act of 1954*, as amended, and a hazardous component subject to the *Resource Conservation and Recovery Act*. [DOE Manual 435.1]

PA/CA REVIEW PLAN. A plan prepared to organize the review of the performance assessment, the composite analysis, or both for a specific disposal facility. The plan is prepared by the Review Team empaneled to perform the review and is approved by the Low-Level Waste Federal Review Group.

PA/CA REVIEW REPORT. The written report of a Review Team describing the findings reached by the Review Team in the course of reviewing for a specific disposal facility the performance assessment, the composite analysis, or both.1

PERFORMANCE ASSESSMENT. An analysis of a radioactive waste disposal facility conducted to demonstrate there is a reasonable expectation that performance objectives established for the long-term protection of the public and the environment will not be exceeded following closure of the facility. [DOE Manual 435.1]

POINT OF ASSESSMENT. The physical location at which monitoring and modeling for facility performance are to be performed. The default point of assessment for a low-level waste disposal facility is the outer perimeter of a 100 meter wide buffer zone around the boundary of the disposal facility. A point of compliance closer to or further from the facility boundary may be used but justification is required. For example, the point of compliance for a disposal facility in a tract to be maintained under institutional control could be argued to be the boundary of the institutional control area.

RADIOACTIVE WASTE MANAGEMENT BASIS. The radioactive waste management controls applied to DOE facilities, operations, and activities to provide near- and long-term protection of public, workers, and the environment. The radioactive waste management basis consists of controls and analyses such as facility waste certification programs, facility waste acceptance requirements, low-level waste disposal facility closure plans, performance assessments, composite analyses and other facility-specific processes, procedures, and analyses made to comply with DOE O435.1 and its Manual. [DOE Manual 435.1]

WASTE ACCEPTANCE CRITERIA. Waste acceptance criteria are the technical and administrative requirements that a waste must meet in order for it to be accepted at a storage, treatment, or disposal facility. [DOE Manual 435.1]

WASTE ACCEPTANCE REQUIREMENTS. Waste acceptance requirements are waste acceptance criteria, and all other requirements that a facility receiving radioactive waste for storage, treatment, or disposal must meet to receive waste (e.g., waste acceptance program requirements, receiving facility operations manual). [DOE Manual 435.1]

WASTE DISPOSAL UNITS. A waste disposal unit is a discrete, essentially continuous volume in which waste is disposed and includes near-field engineered and natural barriers that separate it from other near-by waste disposal units.

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Appendix C - References

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Appendix C - References

1. *Conformance with Safety Standards at Department of Energy (DOE) Low-Level Nuclear Waste and Disposal Sites,* Recommendation 94-2, Defense Nuclear Facilities Safety Board, October 28, 1994.

2. *Format and Content Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* (Draft), U.S. Department of Energy, October 7, 1999.

3. *Guidance for Complying with DOE Order 5820.2A, Radioactive Waste Management, for Onsite Management and Disposal of Low-Level Wastes (LLW) Resulting from Environmental Restoration Activities,* U.S. Department of Energy, January 9, 1997.

4. *Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from Department of Energy (DOE) Low-Level Waste Disposal Facilities,* U.S. Department of Energy, Office of Waste Management, April 1996.

5. *Implementation Guide for Use with DOE M 435.1-1*, Chapter IV, Low-Level Waste Requirements, July 1999.

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7. Interim Format and Content Guide, and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments, U.S. Department of Energy, Office of Waste Management, October 1996.

8. *Interim Review Process and Criteria for Department of Energy Low-Level Waste Disposal Facilities Composite Analyses,* U.S. Department of Energy, Office of Waste Management, October 1996.

9. *Limits for Intakes of Radionuclides by Workers,* International Commission on Radiological Protection, Committee 2, ICRP-30, Parts 1, 2, and 3, 1979, 1980, 1981.

10. *Maintenance of U.S. Department of Energy Low-Level Waste Performance Assessments*, September 1996.

11. *Policy for Demonstrating Compliance with DOE Order 5820.2A for Onsite Management and Disposal of Environmental Restoration Low-Level Wastes Under the Comprehensive Environmental Response, Compensation, and Liability Act,* U.S. Department of Energy, May 31, 1996.

12. *Radiation Protection of the Public and the Environment*, DOE Order 5400.5, U.S. Department of Energy,

13. *Radioactive Waste Management*, DOE Order 435.1, U.S. Department of Energy, July 1999

14. *Radioactive Waste Management*, DOE Order 5820.2A, U.S. Department of Energy, September 1988.

Appendix D - Example Review Plan

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REVIEW PLAN
FOR THE
[SITE NAME]
COMPOSITE ANALYSIS

[MONTH, YEAR]
PREPARED BY THE DOE [SITE NAME]
COMPOSITE ANALYSIS REVIEW TEAM

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Review Plan for the [Site Name] Composite Analysis

1. Introduction
Purpose of this Review Plan
Scope of the Review
Schedule for the Review

2. Review Team
Team Selection
Guidance and Training
Team Members
Review Assignments
Qualifications

3. Site and Facility Visit
Pre-Site Visit Activities
Team Training
Coordination of Site Activities and Information Needs
Agenda
Security and Health and Safety Planning

4. Administrative Record

5. Quality Assurance

6. Technical Review Criteria

7. Attachments
Attachment 1 - Schedule for the Review
Attachment 2 - Reviewer Qualifications
Attachment 3 - Agenda for the Site Visit

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1. Introduction

Purpose of the Review Plan

The purpose of this review plan is to define the mechanisms by which the Review Team will operate in the review of the [Site Name] Composite Analysis, to define the team selection criteria and qualifications, to give an overview of the planned site visit, to discuss team meetings, to define what will constitute the administrative record, to discuss the application of quality assurance criteria to the review, and to detail the technical review criteria.

Scope of the Review

The scope of the review is the [Site Name] Composite Analysis (CA). The two Performance Assessments (PA) for the [Site Name] site and the associated supplemental PA information and Compliance Evaluations will be used as reference material to ensure a consistent approach between the PAs and the CA.

Schedule for the Review

The schedule for the review is tentatively set forth as described in Attachment 1. The deliverable date for the final product will be dependent upon the degree of comment and comment resolution that is necessary for the team to come to a consensus on the adequacy of the document.

2. Review Team

Team Selection

The CA Review Team was selected based on their experience and knowledge of the specific subject areas. The expertise that was determined to be necessary include the following: Waste Characterization, Hydrology, Waste Management, Environmental Restoration, Health Physics, Environmental Regulations, and Safety Analysis.

Guidance and Training

Guidance has been provided to the team members in the form of the Draft PA and CA Review Guidance Manual and in this Review Plan. Training on the guidance, Review Plan, the PA and CA process, and the intended result of our review will be provided prior to the site visit for those team members new to the PA/CA process.

Team Members

Team Leader	DOE-ID
Review Coordinator	LMITCO
Core Member	EH-41
Core Member	DOE-RL

Core Member PNL
Core Member Consultant
Core Member Consultant

Review Assignments

	Environ. Reg.	Environ. Rest.	Health Physics	Hydrology	Safety Analysis	Waste Char.	Waste Mgt.
Team Leader	X			X			
Consultant		X		X		X	
DOE/RL				X	X		X
PNL		X	X				X
Consultant	X					X	
EH-41					X		X
DOE/CH			X			X	

Qualifications

The team members were selected according to their various expertise and existing qualifications and in response to the identified needs for the review. Team member qualifications are included in Attachment 2 of this plan.

3. Site and Facility Visit

Pre-Site Visit Activities

Prior to the site visit, team members are expected to have accomplished several activities. All of the documentation for the applicable PAs, Addendums, and approval authorizations; and the CA should have been delivered to each of the team members. The team members are responsible for understanding the layout of the material for the PAs and the location of the material that is pertinent to each area of expertise, reading the site CA, reading the review guidance, and reviewing and providing comments on the draft Review Plan. In addition, the team will have the responsibility for performing the Completeness Review of the CA prior to arrival at the site.

Team Training

Training will be given prior to the site visit. The training will include an overview of the PA and CA processes, a discussion of the review criteria, and the applicability to the site.

Coordination of Site Activities and Information Needs

Coordination between the Review Team and the site will utilize the Team Leader and the cognizant DOE site Program Manager as the principle points of contact. All information requests need to be coordinated between these two individuals.

Agenda

The draft agenda for the site visit is included as Attachment 3. The description of needed presentations from the CA preparers are preliminary and may change as team members develop their individual lines of inquiry.

Security and Health and Safety Planning

Prior to the site visit, the Review Coordinator will make the necessary arrangements and coordinate the information flow to ensure that security badges are secured for attendees and any other security or clearance matters are handled prior to arrival.

Also, as a part of preparation for the site visit, the Review Coordinator should ensure that necessary health and safety planning has occurred. If the team members are going to be walking in or around areas under which OSHA health and safety and/or other regulations apply, the Review Coordinator needs to identify what the requirements are for each person attending and ensure that necessary training or training waivers is covered so that unnecessary delays or other problems do not occur once the Review Team has arrived at the site.

4. Administrative Record

The Review Coordinator will establish an administrative record file for documenting the review and the results of the review of the CA. All records associated with the review, identified below, shall be a part of the Administrative Record. The record file is subject to and administered in accordance with the Quality Assurance process as identified in Section 5.

The Administrative Record will be maintained by the Review Coordinator and will consist of the following materials:

- Applicable PAs;
- Applicable PAs' Addendums;
- Applicable PA approval authorizations;
- Site CA;
- Meeting minutes from all conference calls;
- Organizational Conflict of Interest forms;
- Site Visit Summary documenting important activities and observations of the site visit;
- All correspondence between the team and the site, the LFRG, and DOE-HQ;
- All comments and comment resolutions; and
- The final Review Team report.

5. Quality Assurance

The CA review will be conducted in accordance with the standards identified in 10 CFR 830.120. Using the graded approach described in paragraph 830.120(b)(1), the Quality Assurance Program for the CA review is contained in this Review Plan. The paragraph that is deemed applicable to this review effort is 830.120(c)(1). Paragraphs 830.120(c)(2) and (c)(3) are deemed to be functions of the Low-Level Waste Federal Review Group in that quality assurance for the following functions involve the oversight of work processes used:

(c)(2) Performance	(i)	Work Processes.
	(ii)	Design.
	(iii)	Procurement.
	(iv)	Inspection and Acceptance Testing.
(c)(3) Assessment	(i)	Management Assessment.
	(ii)	Independent Assessment.

The criteria identified in paragraph (c)(1) is applicable to the review effort and is met as described below.

(c) Quality Assurance criteria.

(1) Management

(i) Program.

A written QAP shall be developed, implemented, and maintained. The QAP shall describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work. The QAP shall describe management processes, including planning, scheduling, and resource considerations.

This criteria is met by the approval of this Review Plan in conjunction with the draft PA and CA Review Guidance Manual.

(ii) Personnel Training and Qualification.

Personnel shall be trained and qualified to ensure they are capable of performing their assigned work. Personnel shall be provided continuing training to ensure that job proficiency is maintained.

The individuals on the team were selected specifically because of their existing qualifications to perform the necessary review. These qualifications are given in Attachment 2. Training for the team is being provided to prepare the team members for the review. This will include a discussion regarding the review processes to be used for the CA review and a historical perspective of the PA/CA process. The training will be conducted prior to the site visit and will include the information identified in Section 3.

(iii) Quality Improvement.
Processes to detect and prevent quality problems shall be established and implemented. Items, services, and processes that do not meet established requirements shall be identified, controlled, and corrected according to the importance of the problem and the work affected. Correction shall include identifying the causes of problems and working to prevent recurrence. Item characteristics, process implementation, and other quality-related information shall be reviewed and the data analyzed to identify items, services, and processes needing improvement.

This criteria will be implemented such that documents and processes that do not meet established requirements shall be identified, controlled, and corrected according to the importance of the problem and the work affected. The process of the technical review and preparing the report and recommendations will be monitored by the Team Leader and corrections will be made as necessary to correct identified deficiencies. It is the responsibility of each team member to identify any opportunities for improvement to the Team Leader.

The final report from the team will include a section which identifies opportunities for improvement in the overall PA/CA review and approval process and in the Guidance Manual.

(iv) Documents and Records.
Documents shall be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish design. Records shall be specified, reviewed, approved, and maintained.

Document preparation and review processes will be conducted to meet the requirements identified in the Guidance Manual and in this Review Plan. Each team member is responsible for the quality of their individual contribution and the Team Leader is responsible for the overall quality of the work products. The records are specified in Section 4 and they will be prepared, and approved by the Team Leader. Maintenance of the records is the responsibility of the Review Coordinator.

6. Technical Review Criteria

A copy of the Technical Review Criteria from the Low-Level Waste Disposal Facility Federal Review Group Manual will be provided and discussed in detail at the Review Team Kickoff Meeting.

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Attachment 1 - Schedule for the CA Review

June 7-11	Finalize Review Team
June 11	Propose Review Team members to the LFRG
June 12 - July 23	Completeness Review of the site CA
July 5	Draft Review Plan to team members
July 14	Comments from the team on the draft Review Plan
July 18	Finalize Review Plan and submit to the LFRG for approval
July 21	Comments due to Review Team Coordinator from the Completeness Review along with a listing of needed documents and interviews/lines of inquiry during the site visit
July 24	Transmittal to the site, the list of additional information, interviews, etc., to be available during the site visit
August 2	Compilation of comments from Completeness Review to Team Leader
August 9-13	Site Visit
August 13 - September 15	Technical Adequacy Review of the CA.
September 15	Review comments due to the Review Team Coordinator.
September 22	Team meeting in Salt Lake City to discuss major comments and any need for additional information, interviews, etc. Transmit comments to the site. Assignments for writing the Review Team Report.
	Upon receipt of comment resolutions, determine any need for additional analysis and the recommendation from the team.
October 15	Complete the Review Team Report and submit to the LFRG along with the recommendation regarding disposition of the applicable CA and the applicable PAs.
November 8-9	Meeting between Review Team and the LFRG.

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Attachment 2 - Team Member Qualifications

Review Team Resumes [outline]

NAME

Educational Background:

Additional Course Work:

Professional Experience [in reverse chronological order]:

Technical Expertise:

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Attachment 3 - Agenda for the Site Visit

Tuesday, August 10

1:00 Training for team members

Wednesday, August 11

8:00 Facility In-brief, badging

8:30 Overview of the CA
Briefly address:
- Coordination of the CA with the Land Use Plan
- Between ER/WM/D&D Programs
- Environmental Monitoring Report

10:00 Hydrology Overview

11:30 Lunch

12:30 Tour of Facilities

6:00 Dinner/Team Meeting

Thursday, August 12

8:00 Identification of contributing source terms

10:00 Process for characterizing source terms

11:30 Lunch

12:30 Additional interviews/briefings as necessary

4:30 Meeting Closeout
Identification of additional information or interviews needed

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Appendix E
Confidentiality and Conflict of Interest Certification

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Confidentiality and Conflict of Interest Certification

To ensure complete independence in performing the performance assessment and composite analysis review, as applicable, each Contractor on the DOE/LFRG Review Team shall agree to and execute an organizational conflict of interest certification statement as given below.

To: _____

From: _____

Regarding my involvement in review of the following project:

_____

(Name of Disposal Facility)

I certify that I will not disclose, except pursuant to the order of a court of competent jurisdiction, any information regarding the subject procurement either during solicitation or evaluation of quotations/proposals, or any subsequent time, to anyone who does not have authorized access to the information, and then only to the extent that such information is required in connection with such person's official responsibilities. I also certify that:

1. I shall not use "privileged information" acquired through my participation in this process for personal gain.
2. I do not have any financial interest that conflicts substantially, or even appears to do so, with duties associated with this process.
3. Neither I, my spouse, nor my child will accept anything of monetary value from any person or company seeking to do business through this project review. (Even seemingly trivial courtesies can present the appearance of impropriety or create a subtle sense of obligation and must be avoided.)
4. I have not participated in any activities or conversations with any parties that would give any potential offeror an unfair competitive advantage on this project review.
5. There are no personal or professional interests, influences, or issues, that will affect my ability to render an impartial, unbiased, and fair evaluation and recommendations.

_____

Signature

_____

Print Name

_____

Date

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ATTACHMENT 1

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DATE: July 22, 1999

SUBJECT: Final Review Team Report for the Hanford Site 200 Area Plateau Composite Analysis and the Immobilized Low-Activity Tank Waste Performance Assessment

TO: Low-Level Waste Disposal Facility Federal Review Group

FROM: Joel Case, DOE-ID Review Team Leader

Attached is the Final Review Team Report for the Hanford Site 200 Area Plateau Composite Analysis and the Immobilized Low-Activity Tank Waste Performance Assessment. The Review Team recommends the following:

- The Performance Assessment for the Immobilized Low-Activity Tank Waste be accepted with the following condition: Hanford shall complete the near-term glass activities on the schedule committed to in the supplemental information contained in Appendix F. The technical support for the assumed performance of the glass waste form was the key issue. The waste form release rate was acknowledged to be the primary mechanism used to limit the radionuclide releases from the disposal facility and to limit potential future doses to exposed individuals. The Performance Assessment lacked supporting technical data to demonstrate the waste form release rate presumed in the analysis can actually be achieved with existing technology. During the course of the review, Hanford provided an analysis of available data supporting the assumed release rate. Hanford also committed to a program to obtain confirmatory data on glass performance. This supplemental information is contained in Appendix F.

- The Composite Analysis for the Hanford Site 200 Area Plateau **be accepted** with the following two conditions: available data or analysis for radionuclide inventories in the Purex tunnels, the chemical separations plants and the CERCLA sites in the 200 Area will be summarized and be incorporated into the composite analysis through bounding sensitivity analyses and the Gable Mountain pond source term be either officially incorporated within the 200 Area disposal buffer zone or commit to remediate it to ensure acceptable dose levels by the planned time of public release.

The scope of this Final Review Report includes the Review Teams' recommendations, a brief description of the review process and a summary of the issues found during the review of the Performance Assessment and Composite Analysis and a recommendation on the two outstanding 200 East and West Area Low-Level Waste Disposal Performance Assessments.. There are also appendices incorporating the following: Review Team plan, meeting minutes, Review Team's evaluation of the review criteria contained in the Low-Level Waste Disposal Facility Federal Review Group Manual, Revision 0, September 1998, Review Team's Analysis of Hanford response to the Hanford 200-East and 200-West Burial Grounds Performance Assessment , maps and the

supplemental information provided by Hanford concerning the Immobilized Low-Activity Waste glass performance.

The Final Review Report will be discussed at the Low-Level Waste Disposal Facility Federal Review Group meeting scheduled for August 15-21, 1999. If there are any questions, please contact me at (208) 526-6795.

Joel Case
Team Leader
DOE Review Team for the RL PA/CA

Attachment 1

Final Report for the Hanford Site 200 Area Plateau Composite Analysis and the Immobilized Low-Activity Tank Waste Performance Assessment

Prepared by the Department of Energy Hanford Site Composite Analysis and the Immobilized Low-Activity Tank Waste Performance Assessment Review Team

July 27, 1999

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Table of Contents

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EXECUTIVE SUMMARY

The purpose of this report is to provide the Low-Level Waste Disposal Facility Federal Review Group with recommendations regarding the technical acceptability of the Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site and the Hanford Immobilized Low-Activity Tank Waste Performance Assessment.

The Composite Analysis provides an estimate of the cumulative radiological impacts from the active and planned low-level waste disposal actions and other potentially interacting sources at the Hanford Site. The Composite Analysis is part of the documentation required for the continued and planned low-level waste disposal operations at the following four facilities:

- post-1988 solid waste burial grounds in the 200 West Area,
- post-1988 solid waste burial grounds in the 200 East Area,
- Environmental Restoration Disposal Facility, and
- disposal facilities for immobilized low-activity wastes.

The Performance Assessment for the immobilized low-activity waste disposal facilities provides the site specific long term environmental information needed to issue a Disposal Authorization Statement that would allow the following:

- modification of the four existing concrete disposal vaults to provide better access for emplacement of the Immobilized Low-Activity Tank Waste containers,

- filling of the modified vaults with approximately 5,000 Immobilized Low-Activity Tank Waste containers and filler material with the intent to dispose of the containers,

- construction of the first set of next generation disposal facilities, and

- filling of the first set of next generation facilities.

The Review Team recommends the Hanford Site 200 Area Plateau Composite Analysis **be accepted** with conditions. There are two key issues and several secondary issues. Though the Composite Analysis did recognize the need to expand the source term, there were significant source terms omitted from the analysis. Specifically noted as being absent are the chemical separation plants, the PUREX tunnels and many CERCLA sites in the 200 Areas. The second key issue was lack of inclusion of the Gable Mountain Pond source term. The Gable Mountain Pond either needs to be incorporated within the 200 Area buffer zone or remediated to ensure acceptable dose levels by the time it is released to the public.

The Review Team recommends the Immobilized Low-Activity Tank Waste Performance Assessment **be accepted** with one condition. There is one key issue and there are several secondary

issues. The key issue is the technical support for the assumed performance of the glass waste form. The waste form release rate is acknowledged to be the primary mechanism used to limit the radionuclide releases from the disposal facility and to limit potential future doses to exposed individuals. The Performance Assessment lacked supporting technical data to demonstrate the waste form release rate presumed in the analysis can actually be achieved with existing technology. However, during the course of the review, Hanford provided an analysis of available data supporting the assumed release rate. Hanford also committed to a program to obtain confirmatory data on glass performance. This supplemental information is contained in Appendix F.

On June 27, 1996, the Department accepted with conditions the Performance Assessment for the 200 West Area burial grounds and on June 30, 1997, the Department accepted with conditions the Performance Assessment for the 200 East Area burial grounds. Hanford has responded to all of the conditions except for one of the conditions regarding the 200 East Area burial grounds.

The Review Team recommends that, upon satisfactory resolution of the conditions of acceptance of the Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site, a Disposal Authorization Statement be issued for the 200 West Area burial grounds.

The Review Team further recommends that upon satisfactory resolution of the conditions of acceptance of the Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site and satisfactory resolution of the one outstanding condition of acceptance for the 200 East Performance Assessment, a Disposal Authorization Statement be issued for the 200 East Area burial grounds. The condition of acceptance for the 200 East Performance Assessment required Richland Operation Office to complete and document a review of the adequacy of waste characterization relative to the needs of the 200 East Area burial grounds performance assessment. Reliability and accuracy of waste characterization was an item of concern raised during the review of the performance assessment. The Review Team recommends the Low-Level Waste Disposal Facility Federal Review Group request a schedule be submitted as to when the adequacy of the waste characterization program against the needs of the Performance Assessment will be performed. The Review Team also recommends that the study be expanded to include the 200 West Area burial grounds performance assessment.

The Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 94-2 notes that the Department and its State and Federal regulators have signed a CERCLA Record of Decision authorizing construction and operation of the Environmental Restoration Disposal Facility. However, the Record of Decision was approved without the substantive features of the composite analysis guidance having been met, and separate Headquarters approval of the composite analysis is required, as noted in the Implementation Plan. The Review Team notes that approval of Hanford's Composite Analysis will satisfy the last remaining technical requirement identified in the Implementation Plan associated with authorization to dispose of CERCLA remediation waste in the Environmental Restoration Disposal Facility.

1.0 INTRODUCTION

1.1 Purpose and Scope

The purpose of this report is to provide the Low-Level Waste Disposal Facility Federal Review Group with recommendations regarding the acceptability of the Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site and the Hanford Immobilized Low-Activity Tank Waste Performance Assessment.

The Composite Analysis was prepared to provide an estimate of the cumulative radiological impacts from the active and planned low-level waste disposal actions and other potentially interacting sources at the Hanford Site. The Composite Analysis is part of the documentation required for the continued and planned Low-Level Waste disposal operations at the following four facilities:

- post-1988 solid waste burial grounds in the 200 West Area,
- post-1988 solid waste burial grounds in the 200 East Area,
- Environmental Restoration Disposal Facility, and
- disposal facilities for immobilized low-activity wastes.

The Performance Assessment for the immobilized low-activity wastes disposal facilities provides the site specific long term environmental information needed to issue a Disposal Authorization Statement that would allow the following:

- modification of the four existing concrete disposal vaults to provide better access for emplacement of the immobilized low-activity waste containers,

- filling of the modified vaults with approximately 5,000 Immobilized Low-Activity Tank Waste containers and filler material with the intent to dispose of the containers,

- construction of the first set of next generation disposal facilities, and

- filling of the first set of next generation facilities.

The scope of this report includes the recommendations of the Review Team, a brief description of the review process, a summary of the major issues found during the review of the Composite Analysis and the Performance Assessment, and a recommendation on the two outstanding 200 East and West Area Low-Level Waste Disposal Performance Assessments. Also included are numerous appendices incorporating the Review Team plan, meeting minutes, comments, Review Team Analysis of Hanford response to the Hanford 200-East and 200-West Burial Grounds Performance Assessment, maps and supplemental information provided by Hanford concerning Immobilized Low-Activity Waste glass performance.

1.2 Composite Analysis and Performance Assessment Review Process

The review of the Composite Analysis and Performance Assessment followed the outline given in the Review Plan for the Hanford Site 200 Area Plateau Composite Analysis and the Immobilized Low-Activity Tank Waste Performance Assessment included in Appendix A. The team was assembled in late November 1998, the Review Plan was drafted and finalized in December 1998. All team members were required to read/review numerous documents prior to the site visit. The documents included, but were not limited to the *Low-Level Waste Disposal Facility Federal Review Group Manual, Department of Energy Order 5820.2A, Hanford Immobilized Low-Activity Tank Waste Performance Assessment, Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site,* and the conditional acceptance letters for the Hanford 200 East and West Burial Ground Performance Assessments.

A site visit to Hanford was conducted the week of January 10, 1999 including a site tour, numerous presentations and exchanges of information regarding the site, the 200 Area Plateau and the plans for the Immobilized Low-Activity Tank Waste disposal facilities. The team prepared individual comments, consolidated the comments into matrices, one for the Composite Analysis and one for the Performance Assessment, included in Appendix C. After group discussion of the comments, recommendations were agreed upon and the report prepared. A draft of the report was presented to the site for factual review, then finalized. A briefing to the Low-Level Waste Disposal Facility Federal Review Group is planned for August 1999.

1.3 Background

The Composite Analysis covers the active and planned low-level radioactive waste disposal areas in the 200 Area Plateau. The purpose of the Composite Analysis is to provide an estimate of the cumulative radiological impacts from active and planned low-level radioactive waste disposal actions and other potentially interacting sources of radioactive material that will remain following Hanford Site closure. The performance objectives in the Department's guidance for the Composite Analysis was 100 mrem in a year; additionally calculated doses must be compared to a dose constraint of 30 mrem in a year to ensure the "as low as reasonably achievable" concept is followed. The 100 mrem in a year limit was the maximum allowable all-pathways dose for 1000 years following Hanford Site closure, which was assumed to occur in 2050. These performance objectives apply to the accessible environment defined as an area between a buffer zone surrounding an exclusive waste management area on the 200 Area Plateau and the Columbia River.

The Performance Assessment examines the long-term environmental and human health effects associated with the planned disposal of the vitrified low-activity fraction of the waste presently contained in Hanford Site high-level waste tanks. The tank waste is the by-product of separating special nuclear materials from irradiated nuclear fuels over the past 50 years. This waste has been stored in underground single and double shelled tanks. The tank waste is to be retrieved, separated into low and high activity fractions, and then immobilized by a private vendor. The Department of

Energy will receive the vitrified waste from the private vendor and plans to dispose of the low-activity fraction in the Hanford Site 200 East Area. The high-level fraction will be stored at Hanford until a national repository is approved. The objective of the performance assessment is to provide a reasonable expectation that the disposal of this vitrified waste will be protective of the general public, groundwater resources, air resources, inadvertent intruder and surface water resources.

2.0 SITE AND FACILITIES DESCRIPTION

2.1 Facilities Overview

The major operational areas at Hanford include:

- The 100 Area, on the south shore of the Columbia River. This is the site of nine retired plutonium production reactors.

- The 200 East and West Areas located on a plateau approximately 6 miles south of the Columbia River. Historically, these areas have been dedicated to fuel reprocessing and waste management and disposal activities.

- The 300 Area located just north of the city of Richland where fuel fabrication facilities were historically operated and currently is the site of nuclear research and development.

- The 400 Area located northwest of the 300 Area is the site of the Fast Flux Test Facility, used in testing breeder reactor systems, and the Fuels and Materials Examination Facility.

- The 600 Area includes the rest of the Hanford site not occupied by the areas listed above.

Appendix E include maps of the Waste Storage and Disposal Facilities in the 200 Area and the Exclusive Waste Management Area and Buffer Zone of the 200 Area Plateau at the Hanford Site.

The Composite Analysis focuses on the 200 Areas only. This area historically housed the chemical separation plants that received and dissolved irradiated fuel and then separated out the plutonium and uranium. At different times and in six different plants, three processes were used to perform the separation of fuel or fuel by-products. From 1944 to 1988, over 500,000,000 gallons of highly radioactive chemical processing waste was placed in single-shell and double-shell tanks in the plateau area. Of this approximately 130,000,000 gallons were discharged to cribs and trenches while approximately 335,000,000 gallons were processed or evaporated. The plateau also contains four existing and one planned low-level waste disposal facilities. Of these, one is a commercial facility operated by US Ecology, Inc and is located southwest of 200 East Area. The three remaining disposal facilities are: post 1988 solid waste burial grounds in the 200 East and West Areas and the Environmental Restoration Disposal Facility. The planned facility is the Immobilized Low-Activity

Waste Disposal facility. Other activities on the plateau include planned reactor graphite core storage and past practice (pre-1988) solid waste burial grounds and discharge cribs, trenches, and ponds.

The Environmental Restoration Disposal Facility was opened in the summer of 1996 for the disposal of wastes generated during excavation and remediation of CERCLA past practice sites. Types of wastes expected include hazardous waste, PCB and asbestos wastes, low-level radioactive waste and low-level mixed radioactive wastes. The disposal facility is lined with a leachate collection system and will be covered with a protective barrier. The other two active Hanford Low-Level Waste disposal facilities are unlined shallow trenches. Both been accepting waste since nuclear materials production and processing began at Hanford. The majority of waste disposed is from the chemical separation plants and the tank farm operations. The 200 West Area facility supports both onsite and offsite generators while the 200 East Area facility supports onsite and United States Navy generators.

The immobilized low-activity tank waste disposal is planned to be conducted in two areas within the 200 East Area, existing underground vaults at the eastern edge and new, yet to be constructed vaults, at the southern edge. The existing vaults, needing retrofit to effectively dispose the immobilized low-activity tank waste were built as part of the program to disposal of double shell tank waste using a grout waste form. The steel reinforced concrete vaults are encased in bituminous sealant and geotextile systems with leachate collection systems. These existing vaults will only be able to handle less than 10% of the projected waste, therefore new disposal vaults are also required for the initial phase of the immobilized low-activity tank waste production. The specific design for the new disposal vaults has not yet been decided, though it will be a simpler concrete vault construction and will contain RCRA constraints if necessary. Design criteria are currently being left flexible.

2.2 Facilities Design and Operational Features

The Composite Analysis calculated doses from potential radioactive releases to the environment from the low-level waste disposal facilities and other sources contained within the 200 Area Plateau. The 200 Area Plateau is in the southwestern quadrant of the Hanford Reservation. This portion of the Hanford Reservation has the greatest depth to groundwater and is designated under the draft Land Use Plan as an exclusion zone within which low-level waste disposal activities take place. The bulk of the radioactivity inventory considered in the Composite Analysis is due to past liquid discharge and solid waste burial sites, which form the largest contributor to the maximum predicted all pathways dose of 6 mrem for the 1000 years following planned closure in 2050. However, the Composite Analysis included a significant separation in time between past-practice liquid discharges, and active and planned disposal facilities. The engineering for the active and planned facilities delay releases so that the maximum predicted all pathways dose occurs after the 1000-year analysis period. The Composite Analysis did not analyze the dosimetric effects past the 1000-year analysis period.

The Immobilized Low-Activity Tank Waste Performance Assessment calculated potential releases to the environment from over 200,000 m^3 of immobilized low-activity waste that will be generated from processing waste currently contained in single and double-walled tanks in 18 tank farms. A

specially formulated glass waste form is envisioned for the immobilized low-activity tank waste disposal facility waste. Waste immobilized in the glass matrix will be sealed into steel boxes and then placed into concrete vaults. The vaults will then be covered with a thick soil cap with capillary break and intruder protection features. The time of compliance for the Immobilized Low-Activity Tank Waste Performance Assessment is 10,000 years, during which the maximum predicted all pathways dose is 6.4 mrem (approximately one-fourth of the limit).

3.0 SUMMARY OF COMPOSITE ANALYSIS REVIEW

The Review Team evaluated the Hanford Composite Analysis which included active, past and planned disposal facilities and other significant source terms on the 200 Area plateau. The Review Team used the Low-Level Waste Disposal Facility Federal Review Group review criteria as the basis for the review. The overall comparison of the Composite Analysis with these criteria is summarized in Section 3.1 and more fully discussed in Appendix C. The issues identified during the review are discussed in Section 3.2 and the key issues are summarized in Section 3.3. The Review Team's recommendations for the composite analysis are presented in Section 3.4.

Based on our review, the Review Team identified a number of favorable attributes of the composite analysis. Some of these attributes are highlighted below:

- This Composite Analysis is the first attempt at a comprehensive site wide, long-term evaluation of future Hanford doses from long-term waste disposal activities.

- Further, this is the first attempt to demonstrate that waste disposal from multiple sources at Hanford meet the applicable requirements.

- The land use considerations presented in the Composite Analysis are the result of continuous efforts with stakeholders to reach decisions on future land uses at Hanford and also meet waste disposal needs.

There are also issues with the composite analysis that caused concern with the Review Team. These issues are more fully described and discussed in Sections 3.1, 3.2 and 3.3.

3.1 Summary by Review Criteria: Complete, Technically Accurate and Valid Conclusions

The review criteria established by the Low-Level Waste Federal Review Group are grouped into the following three categories:

- Is the analysis complete?,
- Is the analysis thorough and technically supported?,
- Are the conclusions of the analysis valid and acceptable?.

Is the analysis complete?
Based on our review, the Composite Analysis is complete with the exception that potentially significant sources have been excluded from the analysis. These sources include the inventories of radionuclides contained in the Purex Tunnels, the chemical separation plants and a large number of CERCLA sites in the 200 Area. Additionally, inventories for ^{99}Tc, ^{129}I and ^{79}Se were missing from a large number of the sites without justification. Secondary waste streams from privatization contractors (i.e. Tank Waste Remediation System) have also been omitted without justification.

Is the analysis thorough and technically supported?
The Composite Analysis is thorough and technically supported with the exception that some major decisions regarding the future land use plans, specifically related to the Gable Mountain pond and plume, have not been made. The results of the composite analysis are conditioned on the assumption that either the buffer zone for the 200 Area disposal exclusion zone will be extended to surround this significant source term or the area will be remediated to meet applicable requirements for radiological release.

Are the conclusions of the analysis valid and acceptable?
The conclusions of the Composite Analysis are valid and acceptable with the exception of the two key issues identified above: (1) omission of potentially significant source terms and (2) incorporation of major decisions regarding the future land use plans, specifically related to the Gable Mountain pond and plume.

All of these issues are discussed more fully in Section 3.2 with additional details in the Composite Analysis matrix found in Appendix C.

3.2 Discussion of the Composite Analysis Review

The Hanford Site 200 Area Plateau Composite Analysis was reviewed versus the detailed Composite Analysis criteria. Two key issues and several secondary issues were identified during the review of the Composite Analysis. A number of additional issues and comments are also noted in Appendix C. The most important these issues are summarized below.

Key Issues

Exclusion of Potentially Significant Source Terms
Several potentially significant sources have been excluded from the analysis. These sources include the inventories of radionuclides contained in the Purex Tunnels, the chemical separation plants and a large number of CERCLA sites in the 200 Area. Additionally, inventories for ^{99}Tc, ^{129}I and ^{79}Se were missing from a large number of the sites without justification. Secondary waste streams from privatization contractors have also been omitted without justification.

The Purex tunnels, chemical separation plants and CERCLA sites in the 200 Area were excluded based on lack of inventory data for these source terms. However, based on discussions during the site visit and knowledge of site operations, we believe that there is sufficient information to provide bounding estimates of releases from these sources. Excluding these sources weakens the analysis. Additional effort should be dedicated to developing bounding estimates for these sources and conducting sensitivity analyses to determine if they significantly affect the results of the analysis.

Secondary waste streams from tank remediation were also not evaluated in the analysis due primarily to uncertainty regarding the content and magnitude of these waste streams. The Tc-99 inventory was assumed to be contained in the glass waste form in the Immobilized Low-Activity Tank Waste disposal facility. However, during our site visit, we heard discussions that the Tc-99 may be separated from the wastes streams leading to Immobilized Low-Activity Tank Waste glass and disposed in the 200 Area as another waste type. This approach may lead to another significant source term that behaves differently than that specified for the Immobilized Low-Activity Tank waste form. Changes in plans for handling secondary waste streams should be monitored and included in future revisions of the composite analysis.

Land Use Planning Relative to the Gable Mound Ponds

Some major decisions regarding future land use plans, specifically related to the Gable Mountain pond and plume, have not been made. The results of the composite analysis are conditioned on the assumption that the buffer zone for the 200 Area disposal exclusion zone will be extended to surround this significant source term. For the conclusions of the composite analysis to be valid, the Gable Mountain pond source term must be formally included into the land use planning surrounding the 200 Area exclusion zone. Alternatively, Hanford could commit to remediating the Gable Mountain pond and related Sr-90 plume. This specific issue highlights the use of the composite analysis as a management tool to evaluate different options for specific source terms.

This issue also highlights the need to finalize the land use planning surrounding the 200 Area exclusion zone and fully integrate with the work of the Hanford land use planning committee. Several options for future land use planning were presented during the site visit and all included the 200 Area exclusion zone. However, the selected land use plan was considered to be static for relatively short time periods with potential revisions to be considered after that time. Long-term land use planning that considers and identifies the 200 Area disposal exclusion zone should be developed based on the efforts of the Hanford land use planning committee.

Secondary Issues

The following secondary issues were also identified during the review. These issues are more fully discussed in Appendix C.

Geochemistry and Transport
Estimates of radionuclide inventories in the high-level waste tanks did not account for chemical effects that may increase inventories of certain radionuclides in the residual solids in the tanks. Technetium-99 is the primary radionuclide of concern.

The use of a "Kd switch depth" for self-mobilizing plumes from the high-level waste tanks may need additional justification. While the concept relates to distinction of near and far field geochemistry, the implementation of the approach needs to justify that the plumes are no longer self-mobilizing at the selected switch depths.

Oxidation/Reduction (redox) potential is a common discriminator for selection of Kds in contaminant transport modeling. However, redox was not used as a discriminator in the selection of Kds in the composite analysis. The report should justify why redox is not an important discriminator of Kds relative to the other discriminators used.

The grid spacing used in the numerical modeling of the saturated zone was used as a constraint for selecting the dispersivity value used in the analysis. This approach does not have a physical basis and leads to increased calculated dispersion of contaminants in the ground water.

Sensitivity Analyses
The analysis would have benefitted from more extensive sensitivity analyses in several areas. The one-dimensional modeling of the vadose zone precluded evaluation of potential fast paths (e.g., clastic dikes) through the vadose zone that may affect estimation of releases. Sensitivity analyses should be conducted to investigate the effects of these potential fast paths through the vadose zone.

The releases from different source types were spaced out in time by assumption. Sensitivity analyses that investigate the consequences of temporally overlapping plumes should be conducted to determine the effects of alternative assumptions.

The modeled release of Tc-99 from the liquid discharge zones result in acceptable doses prior to site closure and the beginning of the period of compliance. These results were based on quicker and smaller releases than observed with existing plumes. Discussion of the conditions that cause the reductions in dose for longer-lived radionuclides (e.g. Fig 4.34(h)) and sensitivity of these results are absent and should have been included in the discussion.

3.3 Summary of Key Issues with the Composite Analysis Review

There are two key issues associated with the composite analysis and several secondary issues. The two key issues are stated below and the secondary issues are contained in Appendix C.

ISSUE 1: Several potentially significant source terms (i.e., Purex tunnels, the chemical separations plants and many CERCLA sites in the 200 Area) were not included in the analysis based

on lack of available data. While exact inventories for these sites are likely not available, there must be some information at the site to permit bounding estimates for these source terms. Sensitivity analyses that include estimated inventories for these source terms should be performed as a condition of acceptance of the composite analysis.

ISSUE 2: The Gable Mountain pond and associated plume, located just to the north of the proposed buffer zone surrounding the 200 Area exclusion zone, contain Sr-90 at concentrations that would exceed dose limits during the period of performance based on the exposure scenarios used in the composite analysis. The discussion of results contained in the composite analysis was predicated on the assumption that the buffer zone would be extended to include this source. This allowed the authors to conclude that the remaining combined source terms did not result in significant calculated doses. To accept this conclusion, the Gable Mountain pond must either be officially incorporated within the 200 Area buffer zone or remediated to ensure acceptable dose levels by the planned time of public release.

This issue highlights the need to finalize the long-term land use planning surrounding the 200 Area exclusion zone and fully integrate with the work of the Hanford land use planning committee. Long-term land use planning documents should be revised to reflect these options as a condition of acceptance of the composite analysis.

3.4 Recommendation for the Composite Analysis

The Review Team recommends that the Composite Analysis **be accepted** with the following two conditions:

- Available data or analysis for radionuclide inventories in the Purex tunnels, the chemical separations plants and the CERCLA sites in the 200 Area will be summarized and be incorporated into the composite analysis through bounding sensitivity analyses.

- Regarding the Gable Mountain pond source term, either officially incorporate it within the 200 Area disposal buffer zone or commit to remediate it to ensure acceptable dose levels by the planned time of public release.

Additionally, the site must address the several comments identified in Section 3.2 and discussed more fully in Appendix C in future revisions of the Composite Analysis.

4.0 SUMMARY OF PERFORMANCE ASSESSMENT REVIEW

The Review Team evaluated the Hanford Immobilized Low-Activity Tank Waste Performance Assessment which includes two disposal facilities. There are the existing grout vaults, suitably modified to accommodate the Immobilized Low-Activity Tank waste form, and future vaults that

have yet to be designed. The Review Team used the Low-Level Waste Disposal Facility Federal Review Group review criteria as the basis for the review. The overall comparison of the performance assessment with these criteria is summarized in Section 4.1 and is more fully discussed in Appendix C. The issues identified during the review are discussed in Section 4.2. A Summary of Key Issue with the Immobilized Low-Activity Tank Waste Performance Assessment Review is presented in Section 4.3. The Review Team's Recommendations for the Performance Assessment are presented in Section 4.4.

This is the first Performance Assessment ever produced for any facility prior to construction and operation. Performance Assessment and its authors have had to address a number of uncertainties and circumstances beyond the control of the project. This includes a new contracting approach, a treatment process that has not been used for secondary waste streams previously, and decisions not yet made for a facility that does not exist. In short, the document addresses a large number of unknowns.

4.1 Summary by Review Criteria: Complete, Technically Accurate and Valid Conclusions

The review criteria established by the Low-Level Waste Federal Review Group are grouped into the following three categories:

- Is the analysis complete?,
- Is the analysis through and technically supported?,
- Are the conclusions of the analysis valid and acceptable?.

Is the analysis complete?
The Immobilized Low-Activity Tank Waste Performance Assessment, with the addition of the supplemental information on waste glass performance contained in Appendix F, is complete.

Is the analysis thorough and technically supported?
The Immobilized Low-Activity Tank Waste Performance Assessment, with the addition of the supplemental information on waste glass performance contained in Appendix F, is thorough and technically supported.

Are the conclusions of the analysis valid and acceptable?
The conclusions of the Immobilized Low-Activity Tank Waste Performance Assessment, with the addition of the supplemental information contained in Appendix F, are acceptable. The conclusions depend heavily on the assumed performance of the glass waste form. Thus, timely completion of the waste form testing program laid out in the supplemental information is critical.

All of these issues are discussed more fully in Section 4.2 with additional details in the Performance Assessment matrix found in Appendix C.

4.2 Discussion of the Immobilized Low-Activity Tank Waste Performance Assessment Review

The Immobilized Low-Activity Tank Waste Performance Assessment was reviewed versus the detailed Performance Assessment review criteria. One key issue, summarized in section 4.3, became apparent. Submittal of the supplemental information on waste glass performance, which mitigated the key issue, led to the conclusion that the Performance Assessment should be conditionally approved. A number of other issues and comments are noted in Appendix C. Some of these issues are summarized below.

Key Issue

Waste form Performance (Short-Term)
The immobilized low-activity tank waste disposal facility will receive the vitrified low-level fraction of waste in the Hanford high-level waste tanks. The vitrification of the waste will be conducted by a vendor. One of the contract specification limits the waste form corrosion rate, as determined by the Product Consistency Test, to a specific fractional release rate. Because no other information is now available on the specific waste form to be produced, the Performance Assessment assumed the specified release rate.

However, the Performance Assessment also must show that this release rate can be expected to be met. One way of showing this result is through comparison of various vitrified waste form release rates to the contract specification. No such information was provided in the Performance Assessment. However, in response to the Review Team's request, the Site provided an analysis of available data supporting the assumed release rate and a commitment to a program to obtain confirmatory data. The supplemental data is provided in Appendix F.

Secondary Issues

The following secondary issues were also identified during the review. These issues are more fully discussed in Appendix C.

Waste Form Performance (Long-Term)
The lack of ability to estimate the long-term performance of the selected waste form warrants continued work. No currently available laboratory tests can predict the long-term release rate from the glass, which is generally presumed to be equal to or lower than initial or forward rate. Laboratory investigations conducted at Pacific Northwest National Laboratory, seek to understand long-term performance of glass waste forms, but the results are preliminary and appear to be closer to fundamental research than a proven and accepted methodology.

Inventory and Waste Form

The assumption that short-term performance and long-term performance of the waste form are equal is not justifiable without further information. More explanation of the relationship of recharge (vadose zone moisture) to potential contaminant release from the waste form is needed.

The Tc-99 inventory appears to be considerably overstated.

Geology/Hydrology

The hydrogeologic framework presented in the Performance Assessment appears reasonable, but could benefit from additional information on the near-field subsurface hydrogeology. Suggestions to support and strengthen the Performance Assessment hydrogeologic framework include the following: 1) include borehole logs and well completion drawings for the three recent boreholes (Fig. 2-13); 2) include additional information on the material types, geology, and subsurface hydrology associated with those boreholes; 3) include tables that list pertinent boreholes and monitor wells with casing type, total depth, top of casing elevation, and well screening information; 4) include a fence diagram to illustrate geology in area of disposal. Figure 2-10 is hard to read and poorly represents borehole locations; consider using a fold-out plate map.

The Performance Assessment should consider expanding the discussion on parameter sensitivity studies for hydrologic properties and strata types that would be encountered along the contaminant flowpath. Specifically, the inclusion of heterogeneities in the vadose zone can lead to fast flow paths.

Facility/Cover

Cover performance is an important element of the disposal design. As presented in the Performance Assessment, the cover design features are confusing regarding the slope of the cover. It is not clear exactly which closure design will be used (see pp. ES-xviii and 6.1). A no-slope cover could create greater deep percolation over the life of disposal. The cover design should consider As Low As Reasonably Achievable concepts (slightly sloping top cover to drain sheet flow in the event of 1000 year precipitation event). Further discussion should include the technical basis for forecasting long-term cover performance. The relationship of long-term cover performance to potential contaminant transport in the vadose zone should be presented in the Performance Assessment.

Specific facility design criteria have not been fully defined such as: cover design, including the hydraulic diverter; getter usage; filler material.

Models

Selection of codes and application of models appear to meet requirements established for this Performance Assessment. However, there should be more commonality in code selection between the Performance Assessment and Composite Analysis. A site-wide flow model could be jointly utilized between the Composite Analysis and Performance Assessment, with disposal areas using common grid and telescoping elements of interest.

The Performance Assessment would benefit from clarification of many fundamental assumptions (see Appendix C). The use of two-dimensional modeling does not permit evaluation of fast flow paths (e.g., clastic dikes). Additional discussion is needed on the algorithm for radionuclide flux transfer between the vadose zone and aquifer models. If the grid sizes are different, artificial dilution is occurring between the unsaturated and saturated zones.

Sensitivity Analysis

It is difficult to completely relate the results of the sensitivity analysis to those of the base case. Many of the sensitivity analysis were performed with a "unit cell" model instead of the "facility" model used in the base case. There was insufficient comparison of the results of the "unit cell" model with those of the "facility" model. This lack of modeling consistency raises concern over the results and conclusions of the sensitivity analysis. Also, additional sensitivity analyses are needed to provide robustness to the analysis (e.g., vadose zone heterogeneities, poorer waste form performance).

As Low As Reasonably Achievable

The As Low As Reasonably Achievable concept should be more rigorously applied to design of the facility and the closure. For example, if as noted, the assumption that the contaminant release is independent of the moisture flux through the facility is valid, then why engineer a capillary break cover? This cost factor could be eliminated. However, if the assumption is not valid, then design specifications of the cover, such as a no-slope cover could create greater deep percolation over the life of disposal. Cover design should consider As Low As Reasonably Achievable concepts rather than place full dependence on the results of a 4-year study. There two depictions of cover design in the Performance Assessment, one with a top slope and one with a flat slope, and there is no discussion of the effects and cost of the two designs. While there is a commendable commitment to further apply As Low As Reasonably Achievable concepts during the detailed design of the facility (See page 4-73), this does not off set the brief and perfunctory discussion of As Low As Reasonably Achievable and the complete reliance of the As Low As Reasonably Achievable discussion on references.

References/Appendices

There seems to be too much reliance throughout the document on the references. For example, the general discussion on subsurface geology seems reasonable, however, details are vague in the Performance Assessment. More traceable details should be presented such as borehole logs and well completion drawings of the three new bore holes. Tables should be included that list pertinent boreholes and monitor wells with total depth, top of casing elevation, and screen length. Figure 2-10 poorly represents borehole locations. Consider using: a fold-out plate map that identifies latitude and longitude coordinate system, and a fence diagram to illustrate subsurface geologic features in the area of disposal.

4.3 Summary of Key Issues with the Immobilized Low-Activity Tank Waste Performance Assessment Review

There is one key issue associated with the Immobilized Low-Activity Tank Waste performance assessment and several secondary issues. The key issue is stated below and the secondary issues are contained in the discussion versus review criteria in Appendix C.

ISSUE: The waste form release rate is the primary mechanism used to limit radionuclide releases from the disposal facility and to limit potential future doses to exposed individuals. However, the Performance Assessment lacked supporting technical data to demonstrate that the waste form release rate presumed in the analysis can actually be achieved. Without objective evidence that achieving the release rate used in the contract specification is feasible, Department of Energy unnecessarily risks significant funds by proceeding with disposal authorization for the Immobilized Low-Activity Tank Waste disposal facility. This lack of information is exacerbated by the results of the base case analysis which, for the drinking water dose from beta/photon emitting radionuclides, is 2.0 mrem in a year versus the performance objective of 4.0 mrem in a year (Performance Assessment, Table 4-4). However, this issue was mitigated by the submittal of supplemental information on waste form release. The supplemental information is contained in Appendix F.

4.4 Recommendations for the Immobilized Low-Activity Tank Waste Performance Assessment

The Review Team recommends that the Performance Assessment for the Immobilized Low-Activity Tank Waste Disposal Facility **be accepted** with the following condition, based on the key issue discussed and summarized in Section 4.2 and 4.3. Additionally, several secondary issues identified in Section 4.2 and discussed more fully in Appendix C should be addressed as the Performance Assessment is maintained.

- Hanford shall complete the near-term glass activities on the schedule committed to in the supplemental information contained in Appendix F.

5.0 200-EAST AREA AND 200-WEST AREA BURIAL GROUNDS PERFORMANCE ASSESSMENTS

In addition to the Environmental Restoration Disposal Facility and the Immobilized Low Activity Waste disposal facility, Hanford has two other low-level waste disposal facilities. These are the burial grounds in the 200 East and 200 West areas.

The Performance Assessment for the 200 West Area burial grounds (*Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*, WHC-EP-0645, November,

1995, M.I. Wood, et al) was conditionally accepted by Department of Energy Headquarters in 1996 (S.P. Cowan to Charles Hansen, *Conditional Acceptance of the Hanford 200 West Area Burial Ground Performance Assessment*, 6/30/96). Hanford responded to all of the conditions in 1996 (Addendum to the Performance Assessment Analysis for Low-Level Waste Disposal in the 200 West Area Active Burial Grounds, HNF-SD-WM-TI-798, Rev. 0, M.I. Wood, 12/20/96). The assessment of responsiveness is in Appendix D.

The Performance Assessment for the 200 East Area burial grounds (*Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*, WHC-SD-WM-TI-730, August 15, 1996, M.I. Wood, et al) was conditionally accepted by Department of Energy Headquarters in 1997 (M.W. Frei to Charles Hansen, *Conditional Acceptance of the Hanford 200 East Area Burial Ground Performance Assessment*, 6/30/97). Hanford responded to all but one of the conditions in 1998 (Addendum to the Performance Assessment Analysis for Low-Level Waste Disposal in the 200 East Area Active Burial Grounds, HNF-2005, Rev. 0, M.I. Wood, 12/21/98). The assessment of responsiveness is in Appendix D.

The following sixth condition has not been responded to:

6. The Richland Operations Office shall complete and document a review of the adequacy of waste characterization relative to the data needs of the 200 East Area Burial Grounds performance assessment. The reliability and accuracy of waste characterization data was an item of concern raised during the review of the performance assessment.

The Review Team recommends that the response to this condition be expanded to include the data needs of the 200 West Area Burial Grounds performance assessment and that it be completed and documented in a timely manner.

The Review Team recommends that, upon satisfactory resolution of the conditions of acceptance of the Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site, a Disposal Authorization Statement be issued for the 200 West Area burial grounds. The Review Team further recommends that upon satisfactory resolution of the conditions of acceptance of the Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site and satisfactory resolution of the outstanding condition of acceptance for the 200 East Performance Assessment, a Disposal Authorization Statement be issued for the 200 East Area burial grounds.

6.0 ENVIRONMENTAL RESTORATION DISPOSAL FACILITY

The Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 94-2 notes that for CERCLA Low-Level Waste disposal facilities, approval of the Record of Decision by Department of Energy Headquarters office, and applicable external regulators, will constitute the authorization to operate. If a Record of Decision is approved without the substantive features of the composite analysis guidance having been met, separate Headquarter approval of the composite

analysis will be required. According to the Implementation Plan (page VII-5), "The Office of Environmental Restoration `Document Review and Approval Level' matrix (dated May 26, 1994) will be revised to indicate Office Director Approval of the composite analysis, which is consistent with the approval level of the Record of Decision."

The Implementation Plan also notes that the Department and its State and Federal regulators have signed a CERCLA Record of Decision authorizing construction and operation of the Environmental Restoration Disposal Facility (page VII-3).

The Review Team notes that approval of the Composite Analysis will satisfy the last remaining technical requirement identified in the Implementation Plan associated with authorization to dispose of waste in the Environmental Restoration Disposal Facility.

7.0 APPENDICES

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APPENDIX C

Review Comments of the Team Members - Criteria Matrix

Composite Analysis for Hanford 200 Area Plateau

Performance Assessment for Hanford Immobilized Low-Activity Tank Waste

Harry Babad Comments on the Composite Analysis for Hanford 200 Area Plateau and for the Performance Assessment for Hanford Immobilized Low-Activity Tank Waste

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Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1 Composite Analysis is Complete			
3.2.1.a. The composite analysis includes a discussion of how the Data Quality Objectives (DQO) process was used as a flexible planning tool and applied to the composite analysis preparation.	Yes	Though a modified Data Quality Objectives (DQO) process was used and defined in the CA due to modeling and forecasting of results, it was reasonable and supported. The composite analysis included a discussion of how the DQO process was used as a flexible planning tool and applied to the composite analysis. See Sections 2.5, 2.6, and 2.7; Table 2.1, and Figures 2.1 and 2.2.	No issues.
3.2.1.b. The composite analysis identifies results, objectives, or milestones of other DOE programs, Federal, state, or local statutes, or agreements (e.g., D&D programs, FUSRAP, CERCLA RODs) that may impact the analysis or conclusions of the composite analysis.	Yes	Pertinent programs, statutes, agreements, etc. are identified. In Section 1.6, plans for the ERDF facility and the TWRS program are discussed. The EIS and ROD for the Hanford reactors are discussed in Section 1.6.2.	No Issues.
3.2.1.c. The composite analysis specifies and justifies the point of assessment for the disposal facility and all other contributing sources.	Yes	The point of assessment is specified on page 1.12 to lie outside a buffer zone that surrounds the "exclusive waste management area". Based on current land use planning at Hanford, the selection of the point of assessment is reasonable and the selection is justified. There are, however, some issues that may need to be dealt with. First, Hanford does not have an approved land use plan. Based on discussions at the 1/11-15/99 team meeting at Hanford, the land use plan, in the form of an EIS, has been in review by DOE HQ for several years. Tom Ferns, in the discussion of land use planning on 1/13, indicated that the time horizon in the draft EIS was "at least 50 years". Given the incomplete land use planning and the associated uncertainty with stakeholders at Hanford, some assessment of the sensitivity of the dose calculation to the point of assessment should have been done.	No approved land use plan. There should be some assessment of the sensitivity of the dose calculation to the point of assessment.
3.2.1.c.1. The point of assessment is the publicly accessible point of maximum impact reasonably expected for future members of the public for the time period of assessment.	Yes	Same as Section 3.2.1.c response.	Same as Section 3.2.1.c issues.
3.2.1.c.2. The point of assessment selected is supported by land use plans or reasonably conservative assumptions that are justified	Yes	Same as Section 3.2.1.c response.	Same as Section 3.2.1.c issues.
3.2.1.c.3. Changes in the point of assessment as a function of time are justified.	Yes	Same as Section 3.2.1.c response.	Same as Section 3.2.1.c issues.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1.d. The composite analysis identifies all sources of radioactive material in the ground that could contribute to the potential future doses from the LLW disposal facility. Sources selected for the composite analysis and the reasons for excluding any source are justified. Other potential sources of radioactive material to be considered include wastes disposed of prior to 1988, other LLW disposal facilities, transuranic waste or alpha LLW disposal, buildings, tanks, cribs, spills, ditches, seepage basins, and leaks. Sources selected should include all sources that could make a significant contribution to potential future doses associated with the LLW disposal facility	No	The composite analysis has considered all known potential sources of radioactive material in the ground that could contribute to dose from the LLW disposal facilities. However, a number of sources are excluded with little justification. For example, the Chemical Separation Plants (Section 3.3.1.) were excluded on the basis that the residual inventory is unknown and that "It appears unlikely that the canyon buildings will be a significant source of groundwater contamination, especially in the next 1000 years." A sensitivity case was analyzed for a canyon building and filters, but the case only considered ^{137}Cs and ^{90}Sr (page 3.5). In addition to the Chemical Separation Plants, the Purex tunnels were excluded (page 3.6). Again, the justification for exclusion is weak (no inventory for important radionuclides and expected robust closure). A large number of CERCLA sites were excluded on the basis that there was no recorded inventory. Of 363 CERCLA sources without inventories listed in Appendix C, only 18 are not described as either radioactive or mixed. It seems possible that potentially significant past-practice waste sites have been omitted from the analysis without justification. On page 3.19, in Section 3.4.5, CERCLA Sources, it is stated that "The CERCLA source term does not include past-practice waste sites that are under the jurisdiction of tank farm operations or decontamination and decommissioning." These sources may include the direct releases from canyon buildings and tanks noted by Harry Babad. As a whole, the omission of these sources, particularly the canyons and tunnels, weakens the analysis. Despite the lack of reported inventory of important radionuclides e.g. I-129, a bounding analysis should have been done to indicate the potential contribution of these sources.	Potentially significant sources excluded: Chemical Separation Plants, Purex Tunnels, large number of CERCLA sites. The omission of these sources weakens the analysis.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1.e. The composite analysis identifies and quantifies all radionuclides present in the LLW disposal facility and all other contributing sources of radioactive material that could contribute significantly to the total potential dose. Inventory estimates included in the analysis are justified.	Yes	In section 3.4.1, the radionuclides potentially important to the CA are identified. This effort used screening analyses from previous studies. Due to the long travel time to the water table and the 1,000-year period of analysis, only those radionuclides that are long-lived and have very low K_ds were deemed important; this approach is consistent with the Hanford site characteristics and the DOE requirements. The exclusion of ^{187}Re from the analysis based on its small inventory is justified. Generally, the estimation of radionuclide inventories is reasonable and well documented. In instances where more than one estimate of inventory was made, the larger was generally used. However, there are a few potential issues. The CA states, on page 3.10, that several isotopes of uranium (i.e., ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{238}U) were considered. However, only ^{238}U was simulated. The other uranium isotopes were assumed to be present in proportion determined by ORIGEN calculation. It is not clear that this approach properly accounts for the shorter-lived ^{233}U and ^{234}U isotopes. The CA states, on page A.4, that the actual enrichment of fuel used in the Hanford reactors was higher than that analyzed. No justification for this assumption is provided. No estimate on the effect of this assumption on the results of the CA is given. Secondary waste streams from privatization contractors have been omitted without justification. These streams will likely contain mobile, long-lived radionuclides (e.g., ^{129}I) of importance to the CA. Inventories of some of the key radionuclides have not been included in the estimated inventories of some sources. In particular, as shown in Table 3.11, ^{129}I and ^{79}Se are not included in the TWRS Double-Shell Tank residuals. Also, ^{129}I and ^{79}Se are not included in the ERDF inventory. These inventories could have been estimated in the same way as for other sources. Table 3.7 lists inventories of selected radionuclides for liquid discharge sites. However, inventories for ^{99}Tc and ^{129}I are missing from a large number of the sites with no justification provided. The projected inventory of the ERDF facility is significantly overestimated in this analysis. In the composite analysis, the maximum concentrations of radionuclides in materials in cleanup areas was multiplied times the estimated total volume of materials to be disposed in ERDF. However, the <u>average</u> concentration of radionuclides in materials disposed at ERDF is likely to be an order of magnitude lower than the maximum concentration. Consequently, the ERDF inventory and resultant doses are significantly overestimated. (See discussion in Section 3.4.3, page 3.14 *et seq.*).	Did not properly account for short lived ^{233}U and ^{234}U isotopes. The enrichment of fuel used in Hanford reactors was higher than analyzed. ^{129}I and ^{79}Se not included in TWRS Double Shell Tank Residuals or in ERDF. Secondary waste streams from privatization contractors omitted. Inventories of ^{129}I and ^{99}Tc omitted from a number of liquid discharge sites.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1.e.1. The estimates of radionuclide species and inventories in the sources selected for consideration are derived from referenced documentation or data summaries presented in the composite analysis and are based on existing records, process knowledge, or site investigations (e.g., Remedial Investigations, Feasibility Studies).	Yes	Same as Section 3.2.1.e response.	Same as Section 3.2.1.e issues.
3.2.1.e.2. Extra-polations are made and justified from known data to estimate radionuclides and inventories where clear information does not exist.	Yes	Same as Section 3.2.1.e response.	Same as Section 3.2.1.e issues.
3.2.1.f. The composite analysis provides a reasonable methodology for estimating the release of radionuclides from the contributing sources selected for the composite analysis based on available data.	Yes	The methodology for estimating release of radionuclides, as described in Section 4.1.1 and Appendix D, includes models for seven waste types: liquid releases, soil-debris, cake (e.g., tank salt cake), glass, cement, reactor graphite block, and atmospheric releases. The waste type models are clearly identified with specific sources in the analysis. The release models account for the physical and chemical characteristics of the waste and contaminated zones. The release models for these five waste types are reasonable for the level of detail and the available data used in the analysis. As part of the release model, the assumed rates and durations of recharge for each disposal facility are listed in Table 4.5 and described in 4.1.2.1. The duration of recharge for the various disposal facilities indicates the assumed performance of the cover systems assigned to these sources.	No issue.
3.2.1.f.1. The estimates of the release of radionuclides include the effects of CERCLA actions prescribed in RODs or similar binding agreements such as those associated with D&D.	Yes	Same as Section 3.2.1.f response.	No issues.
3.2.1.f.2. The release mechanisms consider the physical and chemical characteristics of the source materials and the site characteristics.	Yes	Same as Section 3.2.1.f response.	No issues.
3.2.1.f.3. Assump-tions incorporated into the analysis are identified, justified, and consistent with the conceptual model of site behavior presented in the performance assessment conducted on the LLW disposal facility.	Yes	Same as Section 3.2.1.f response.	No issues.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1.g. The composite analysis presents a reasonable methodology for estimating the transport of radionuclides to the point of assessment from all sources based on the available data for characterizing environmental behavior.	Yes	The description of the methodology for transport of radionuclides through groundwater and its accompanying assumptions are complete. Source release models and data are described in Sections 4.1.1, 4.1.2.1 and Appendix D (see Criterion 3.2.1.f). A one-dimensional model of the vadose zone was used based on the large number of sources and limited characterization of the vadose zone (Section 4.1.2.1). An existing three-dimensional groundwater flow model was used in the analysis (Section 4.1.3). A three dimensional model was necessary to calculate the potential for overlapping plumes from the various sources. The analysis of the air pathway (section 3.3.2) was limited to volatile radionuclides released from the reactor graphite cores. The limited analysis is reasonable and consistent with past performance assessment.	No issues.
3.2.1.g.1. Mathe-matical modeling of the transport of radionuclides is commensurate with the available site data.	Yes	Same as Section 3.2.1.g response.	No issues.
3.2.1.g.2. Assump-tions incorporated into the mathematical models are identified, justified, and consistent with the conceptual model of site behavior presented in the performance assessment conducted on the LLW disposal facility.	Yes	Same as Section 3.2.1.g response.	No issues.
3.2.1.g.3. Mathe-matical models selected are documented and verified either in referenced publications or in the appendices of the composite analysis.	Yes	Same as Section 3.2.1.g response.	No issues.
3.2.1.h. The composite analysis provides a complete discussion of all important exposure pathways for the evaluation of potential doses to a hypothetical, individual member of the public at the point of exposure for any time during the period of assessment. The exposure pathways identified in the composite analysis should be consistent with the exposure pathways in the performance assessment. The exposure pathways considered in the composite analysis include only those pathways that are related to the exposure of individual members of the public at the point of assessment and are justified.	Yes	The CA provides a complete discussion of all important exposure pathways (Section 4.1.6). Consideration of pathways is complete, consistent with Hanford PAs, and appropriate for exposure of hypothetical futures members of the public.	No issues.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1.i. The composite analysis provides a coherent presentation of the relevant descriptive information concerning the disposal site, its location on the DOE site, and its proximity to other sources of radioactive material. The sources of radioactive material are described along with the methodology for assessing the migration of radionuclides to the point of assessment, and the exposure scenarios following transport.	Yes	All necessary information is coherently presented. Sources, methodology and scenarios are described adequately. However, potentially significant sources are excluded with insufficient justification (see criterion 3.2.1.d)	Omission of sources see criterion 3.2.1.d.
3.2.1.j. The composite analysis presents an assessment using the time of 1000 years for exposures to hypothetical members of the public with all disposal facilities closed, decontamination and decommissioning completed, and operations at the DOE site terminated. The assessment establishes a "base case," that is a reasonable conservative, but realistic case for comparison with the dose limit and dose constraint.	Yes	The CA has established a reasonable base case, (except for the omission of potentially significant sources such as the Purex tunnels, Canyon facilities and 200 Area CERCLA sites, see criterion 3.2.1.d), with due consideration of projected future closure of the Hanford site. The assessment has covered a 1,000-year period for exposures to hypothetical future members of the public.	Omission of sources see criterion 3.2.1.d.
3.2.1.k. The calculated results presented in the composite analysis are consistent with the site characteristics, waste characteristics, and the conceptual model of the DOE site. The calculated results are consistent with available site monitoring data and any other data from supporting field investigations.	Yes	The results presented are generally consistent with the site characteristics, waste characteristics and conceptual model. The results were compared with available data.	No issues

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1.l. The sensitivity or uncertainty of the results are analyzed, including the consideration of alternative land uses and remedial actions. Uncertainties in radionuclide inventories for the disposal facility and other contributing sources are analyzed.	Yes	Sensitivity analyses associated with alternative land use and remedial actions were specifically not investigated in this first iteration analysis (Section 5.1.2) because these future states will be (have not yet been) decided by DOE, the US EPA, Tribal Governments, municipal governments and other stakeholders, and the Washington Department of Ecology. However, four exposure scenarios were evaluated, effectively evaluating the range of future land use scenarios including small-scale agricultural, residential, industrial, and recreational. Uncertainty in the radionuclide inventories of the multiple sources and their mobilities are discussed in Section 5.1.2. No specific quantitative analyses are conducted for the inventories and a case is made for the virtual impossibility of making meaningful quantitative sensitivity analyses because of the absence of inventory information. Discussions are presented that conservative overestimation of inventories providing results that are within performance objective make a reasonable bound of actual inventories without quantifying the influence of an uncertain inventory (p. 5.7). The sensitivity of the vadose zone model (Section 4.1.2.4), the groundwater transport model (Section 4.1.4.4) and the exposure model (Section 4.1.6.4) were investigated.	No issues
3.2.1.m. The calculated results and the sensitivity or uncertainty analysis results are interpreted to evaluate meeting the dose constraint of 30 mrem/year and the dose limit of 100 mrem/year at the point of assessment over the period of assessment.	Yes	The calculated results are interpreted to evaluate meeting the dose constraint and dose limit beyond the buffer zone for 1000 years (Section 5.1). The discussion identified past liquid discharges as the only significant sources for contributing to future doses to individuals assumed in the exposure assessment during the compliance period. The agricultural exposure scenario is identified as providing the highest calculated doses from among the four exposure scenarios considered. However, calculated doses are interpreted as meeting the dose constraint and dose limit starting at the time of site closure (year 2050). Results presented in Figures 4.34 and 4.35 indicate a sharp decrease in dose in the 50 years just prior to the beginning of the period of analysis at site closure. While most of this dose is attributed to tritium and the dose reduction in time is associated with tritium decay, doses from other longer-lived radionuclides (e.g., Tc-99 in Figure 4.34(h)) also decrease sharply to low levels just prior to the period of analysis. Discussion of the conditions that cause these reductions in dose and sensitivity of these results are absent.	Discussion for conditions that cause reductions in dose from longer-lived radionuclides prior to beginning of period of performance is absent.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.1.n. An options analysis is performed that identifies alternative actions which could be performed to reduce potential doses to a member of the public for results which exceed the dose constraint. The options analysis also identifies alternative actions which could be performed to reduce potential doses to a member of the public for results that exceed the dose limit.	NA	Not applicable	No issues
3.2.1.o. The need for an ALARA assessment is presented based on the results of the composite analysis and, if warranted, an assessment is performed to identify a need for actions to further reduce the doses calculated in the analysis.	Yes	The need for an ALARA analysis is discussed in Section 5.3. The Composite Analysis result is an all-pathways dose that is well under the 30 mrem/year dose constraint. Thus, a qualitative ALARA assessment was done to consider the potential value of a more detailed analysis. The assessment used a conservative average dose from the agricultural scenario of 4 mrem/year over the 1,000 year compliance time. The exposed population was conservatively estimated as 1,000 people. Using a collective dose value of $1,000 to $10,000 per person-rem, it was concluded that a more detailed analysis is not justified.	No issues
3.2.1.p. The composite analysis includes appendices or references to published documents that provide a basis for the discussions in the composite analysis.	Yes	The composite analysis provides adequate references and appendices to provide supporting documentation to the analysis.	No issues

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2. The Composite Analysis is Thorough and Technically Supported			
3.2.2.a. The composite analysis presents an estimate of the radionuclide inventory of the radioactive material considered in the analysis and justifies the estimate. This estimate is based on an examination of the waste disposal records, process knowledge, historical information related to the disposal facility and the contributing sources, and documents describing potential contributing sources of radioactive material such as Remedial Investigations and Feasibility Studies for cleanup actions, and other appropriate studies.	No	See comments versus criterion 3.2.1.e. Secondary waste streams from privatization contractors have been omitted without justification. These streams will likely contain mobile, long-lived radionuclides(e.g., ^{129}I) of importance to the CA. Inventories of some of the key radionuclides have not been included in the estimated inventories of some sources. In particular, as shown in Table 3.11, ^{129}I and ^{79}Se are not included in the TWRS Double-Shell Tank residuals. Also, ^{129}I and ^{79}Se are not included in the ERDF inventory. These inventories could have been estimated in the same way as for other sources. Table 3.7 lists inventories of selected radionuclides for liquid discharge sites. However, inventories for ^{99}Tc and ^{129}I are missing from a large number of the sites with no justification provided.	^{129}I and ^{79}Se not included in TWRS Double Shell Tank Residuals or in ERDF. Secondary waste streams from privatization contractors omitted. Inventories of ^{129}I and ^{99}Tc omitted from a number of liquid discharge sites.
3.2.2.a.1. All of the radionuclides anticipated to be present in wastes and in the contributing sources are considered in the composite analysis. Any radionuclides that are screened from the analysis are identified and their exclusion justified as being insignificant contributors to the total dose estimated in the analysis.	No	Same as Section 3.2.2.a response.	Same as Section 3.2.2.a. issues.
3.2.2.a.2. The known physical and chemical characteristics of the radioactive materials considered in the composite analysis are included in the generation of the source terms and the transport of the radionuclides.	Yes	Generally, the physical and chemical characteristics of the waste and radionuclides were taken into account in developing source terms and simulating transport (e.g., K_ds were varied in the vadose zone to account for chemicals associated with the radionuclides released from tanks). However, the consideration of residuals in the high-level waste tanks did not account for chemical differences that would influence quantities of certain radionuclides (i.e., technetium) in the residue. See detailed comments by H. Babad (Appendix D)	Residuals in the high-level waste tanks did not account for chemical differences that would influence quantities of certain radionuclides (i.e., technetium) in the residue.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.b. The conceptual model used for the composite analysis is consistent with the representation of the conceptual model used in the performance assessment, and includes the major mechanisms affecting the transport of radionuclides at the DOE site. The components of the conceptual model for the composite analysis are reasonably represented in the analysis of the LLW disposal facility and other contributing sources.	Yes	The conceptual models used in the Composite Analysis (CA) and Performance Assessment (PA) for the TWRS ILAW facility are similar in that they consider the primary exposure pathway to be from transport of contaminants through the vadose zone and ground water systems based on advection and dispersion. The level of complexity of the conceptual models is appropriate for the intended use. However, the following general comments should be noted. A one-dimensional transport model of the vadose zone is used to represent each of the many individual contaminant sources (Section 4.1.2). However, the use of a one-dimensional vadose-zone model prevents assessment of possible fast flow paths and capillary diversion. This effect could be investigated in additional sensitivity analyses. The use of a factor of three to modify the cross-sectional area of the one-dimensional domain to account for contaminant spreading does not have a good basis. In fact, use of this factor did not provide good matches with observed Tc-99 in the aquifer (p. 4.11, Section 4.1.2.3). Use of the one-dimensional vadose-zone model forced the infiltration rates to be below the saturated conductivity of the lowest conductivity materials. This artificially prescribes a limit on the amount of infiltration that can flow through the vadose zone. The effectiveness of the capillary barrier could not be modeled mechanistically and had to be assumed in the one-dimensional model. Thus, the effects of spurious breakthrough points in the surface barrier could not be observed.	Need to do additional sensitivity analyses to look at effects of potential "fast paths" in vadose that could not be modeled in 1-D calculations. Need to justify "Kd switch depth" for "self mobilizing" plumes from tanks. Need to justify constant head boundary for river if major agricultural pumping may occur. Need to justify why redox is not an important discriminator of Kds relative to the other discriminators used.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.b. The conceptual model used for the composite analysis is consistent with the representation of the conceptual model used in the performance assessment, and includes the major mechanisms affecting the transport of radionuclides at the DOE site. The components of the conceptual model for the composite analysis are reasonably represented in the analysis of the LLW disposal facility and other contributing sources.	Yes	The use of a distribution coefficient (Kd) "switch depth" (p. 4.9) below tanks to model releases from the tanks may need additional justification. As currently configured, this approach assigns a lower Kd value to the self-mobilizing contaminant plume to account for observed migration of tank leak plumes at depth. Then, at a specified "switch depth", a higher Kd value is assigned implying immobility below this depth. This conceptual model may not be well justified for a self-mobilizing plume unless a persuasive argument can be presented that the plumes have lost their self-mobilizing capability. In addition, the switch depth entries in Table 4.4 are not always consistent for similar wastes at different sites. For example, a comparison of concentration plots for pH or nitrate (as an indicator of the geochemical altering plume) and cesium-137 that showed that both concentrations tapered off at the same depth may be an effective demonstration that the plume has lost its self-mobilizing capabilities. The behavioral same radionuclides may be reflected by the behavior of Cs-137 which is the indicator for the switch depth.	
3.2.2.b. The conceptual model used for the composite analysis is consistent with the representation of the conceptual model used in the performance assessment, and includes the major mechanisms affecting the transport of radionuclides at the DOE site. The components of the conceptual model for the composite analysis are reasonably represented in the analysis of the LLW disposal facility and other contributing sources.	Yes	A three-dimensional model of the saturated zone is used to track potentially overlapping plumes from the various sources. The groundwater flow model characterizes the Columbia River as a constant head boundary based on the 1979 water level measurements. This assumption seems reasonable for near-term time steps, however, for far-term time steps (i.e., hundreds of years), a more rigorous evaluation of this boundary may be needed, particularly due to potential pumping scenarios based on land use options. The assignment of Kds as a function of major geochemical conditions is a valuable contribution to the analysis. However, oxidation/reduction potentials should be considered as a discriminator along with organic content, salt content, and pH unless it can be shown that the latter effects predominate in the plumes from the tanks.	
3.2.2.c. Credits for CERCLA actions or other remedial actions are represented in the conceptual models used in the composite analysis, and are justified by supporting or referenced documentation.	No	Credits are taken for CERCLA actions in some site areas. However, major decisions for cleanup activities in the 200 area have not been made. Consequently, there are no documents or other references for possible cleanup activities in these areas and this requirements is not applicable at this time.	Major decision for clean-up have not made.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.d. Source terms and flow and transport models in the composite analysis are commensurate with the available data, incorporate the important characteristics identified in the performance assessment, and provide results consistent with the performance assessment.	Yes	The duration of recharge for the various disposal facilities indicates the assumed performance of the cover systems assigned to these sources. While the rate of recharge information is complete in Table 4.5, two changes in presentation will improve interpretation. We suggest (1) the use of the actual assumed recharge rate rather than an index be used for the recharge rate and (2) a "key" to the source naming system to determine the type of facility being described (e.g., Is 218-W-5 a solid waste burial ground and how do we know?). These changes would permit much easier interpretation of the source term assumptions. Large areas in the 200 Area are assumed to be covered with low-infiltration covers. Do the edges of these covers provide paths of higher recharge due to directing infiltrating water away from the disposal areas? If so, what would be the effect of this focused recharge on the movement of contaminants in the vadose and groundwater? The last paragraph on page 4.11 seems to indicate that the assumed spreading of plumes from liquid discharges resulted in quicker releases of Tc to the groundwater than observations imply. If this is the case, might the calculated doses from Tc-99 (that are shown to decrease rapidly just before the compliance period) be shown to occur after the beginning of the period of analysis at 2050 and therefore impact the analysis?	Suggest reformatting Table 4.5 to present data in a more coherent and usable fashion by (1) grouping similar waste types (tanks, spills, disposal areas) so that the common treatment of these groups becomes apparent; (2) use actual recharge values instead of an index. Are there edge effects surrounding the very large cover systems that may direct recharge water in a way that needs to be considered? Suggest discussion and possible sensitivity analyses to explore. Does the modeled accelerated release of Tc in the liquid discharge areas bear on the early release prior to site closure that may change the results if modeling were to match existing plumes? Suggest sensitivity analyses to explore.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.e. The assumptions in the composite analysis related to the radionuclides to be considered, to the inventories of radionuclides, the source term evaluation, and the transport of radionuclides are justified.	No	Generally, the assumptions in the CA related to the radionuclides to be considered,(Section 3.4.1), to the inventories of radionuclides, the source term evaluation, and the transport of radionuclides are justified. There are, however, some areas of weakness. In the identification of sources to be included in the CA, a number of sources are excluded with little justification. For example, the Chemical Separation Plants were excluded on the basis that the residual inventory is unknown and that "It appears unlikely that the canyon buildings will be a potentially significant source of groundwater contamination, especially in the next 1000 years." A sensitivity case was analyzed for a canyon building and filters, but the case only considered ^{137}Cs and ^{90}Sr. In addition to the Chemical Separation Plants, the Purex tunnels were excluded. Again, the justification for exclusion is weak (no inventory for important radionuclides and expected robust closure). A large number of CERCLA sites were excluded on the basis that there was no recorded inventory. Of 363 CERCLA sources without inventories listed in Appendix C, only 18 are not described as either radioactive or mixed. Table 3.7 lists inventories of selected radionuclides for liquid discharge sites. However, inventories for ^{99}Tc and ^{129}I are missing from a large number of the sites with no justification provided.	Excluded sources from Chemical Separation Plants, Purex Tunnels, and 200 Area CERCLA sites with little justification. Inventories for ^{99}Tc and ^{129}I are missing from a large number of the sites with no justification provided. Secondary waste streams from privatization contractors have been omitted without justification.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.e. The assumptions in the composite analysis related to the radionuclides to be considered, to the inventories of radionuclides, the source term evaluation, and the transport of radionuclides are justified.	No	It seems possible that potentially significant past-practice waste sites have been omitted from the analysis without justification. On page 3.19, in Section 3.4.5, CERCLA Sources, it is stated that "The CERCLA source term does not include past-practice waste sites that are under the jurisdiction of tank farm operations or decontamination and decommissioning." These sources may include the direct releases from canyon buildings and tanks noted by Harry Babad. The CA states, on page 3.10, that several isotopes of uranium (i.e., ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{238}U) were considered. However, only ^{238}U was simulated. The other uranium isotopes were assumed to be present in proportion determined by ORIGEN calculation. It is not clear that this approach properly accounts for the shorter-lived ^{233}U and ^{234}U isotopes. The CA states, on page A.4, that the actual enrichment of fuel used in the Hanford reactors was higher than that analyzed. No justification for this assumption is provided. No estimate on the effect of this assumption on the results of the CA is given. Secondary waste streams from privatization contractors have been omitted without justification. These streams will likely contain mobile, long-lived radionuclides of importance to the CA. Inventories of some of the key radionuclides have not been included in the estimated inventories of some sources. In particular, as shown in Table 3.11, ^{129}I and ^{79}Se are not included in the TWRS Double-Shell Tank residuals. Also, ^{129}I and ^{79}Se are not included in the ERDF inventory. These inventories could have been estimated in the same way as for other sources.	

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.f. Any mathematical models used in the composite analysis for analyzing the transport of radionuclides to the point of assessment are appropriate for the LLW disposal facility and all other contributing sources. The mathematical models used in the composite analysis provide calculated results that are representative of the results calculated in the performance assessment for similar wastes in similar disposal facilities.	Yes	The mathematical models used in the analysis appear to be appropriate for the level of data available and the conceptual model. Sources of data are generally identified. The results of the groundwater analysis are compared with six other analyses of performance at Hanford (Section 5.2). The site-specific analyses were found to use more conservative parameter estimates than the "best estimates" used in the CA. However, the results tended to suggest a fundamental consistency among the analyses. In Table 4.7, the units for van Genuchten "α" and van Genuchten "n" appear to be switched. Also, the basis for the assumed distributions in the hydrologic parameters is not clear. The use of a longitudinal dispersivity of 95 m in the saturated zone is justified on p. 4.27 (Section 4.1.4) with three constraints. However, using the grid spacing as a constraint for the dispersivity does not have a physical basis. Rather than having a large dispersivity to offset a large grid-block size to yield a small grid Peclet number, perhaps the grid should be refined. Having a large grid-block size also contributes to numerical dispersion. The overall effect of including both large numerical dispersion and mechanical dispersion will be to create more disperse plumes in the saturated zone with lower peak concentrations (albeit faster travel times in the early period). In Table D.2 there are differences among some isotopes of the same element for chemical and physical properties that should be constant for an element? For example solubilities for curium; cement diffusion for Am, Cs, Co and Cm. These differences should be explained and justified. Appendix E contains a nice presentation and justification for the selected Kd values.	Van Genuchten units are switched, grid spacing as a constraint for the dispersivity does not have a physical basis and leads to increased calculated dispersion. Differences parameter values in Appendix D should be explained.
3.2.2.f.1. The input data are based on field data from the site, laboratory data interpreted for field applications, referenced literature sources which are applicable to the site, or related analyses performed for the performance assessment. Any assumptions used to formulate input data are justified and have a defensible technical basis	Yes	Same as Section 3.2.2.f response.	Same as Section 3.2.2.f issues.
3.2.2.f.2. Inter-mediate calculations are performed, and the results are presented to demonstrate the composite analysis calculations are representative of the site and are consistent with results presented in the performance assessment for similar situations.	Yes	Same as Section 3.2.2.f response.	Same as Section 3.2.2.f issues.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.g. The dose analysis performed for the composite analysis is consistent with that performed for the performance assessment for similar exposure pathways and similar exposure scenarios.	Yes	The dose analysis presented in Section 4.1.6 is consistent with the dose analysis presented in the Hanford PAs. Per guidance for the Composite Analysis, there was no analysis of dose to inadvertent intruders. Four exposure scenarios (agricultural, residential, recreational, and industrial) were evaluated. Appropriate dose conversion factors were used.	No issues.
3.2.2.h. The sensitivity or uncertainty analysis considers factors such as alternative land use plans, remedial actions, radionuclide inventories, site and facility characteristics, and transport parameters to provide reasonable estimates of potential doses at the point of assessment for the period of the assessment. The maximum projected dose over the period of the assessment (at least 1000 years) is presented at the point of assessment.	Yes	The sensitivity of the vadose zone model (Section 4.1.2.4) was investigated by varying the cross-sectional areas of the one-dimensional columns, the rates of recharge, initial soil-moisture condition, and distribution coefficients. The sensitivity of the groundwater transport model (Section 4.1.4.4) was really a comparison of release rates to the groundwater at nodes representing the 200W, 200E and US Ecology site. No analysis of sensitive parameters in the groundwater model (e.g., potential changes that would affect overlapping plumes) was conducted. Results that indicate minimized temporal overlapping of plumes from different sources are strongly dependent on the assumed duration of facility covers. For example, it appears that former liquid releases are calculated to begin migration at the time of their emplacement, releases from tanks are calculated to begin migration at time of waste removal in the near term, tank residuals and pre-88 burial ground source migration are delayed by 500 years, and migration from post-88 burial ground are delayed by 1000 years after closure. The analysis demonstrated that only highly mobile radionuclides (Kd = 0) will reach the performance boundary within 1000 years. Therefore, the source terms represented by past leaks, tank releases, pre-88 dry disposal, and post-88 dry disposal are effectively spaced-out in time to preclude interacting plumes. Sensitivity analyses that investigate the consequences of temporally overlapping plumes should be conducted. Sensitivity analyses associated with alternative land use and remedial actions were specifically not investigated in this first iteration analysis (Section 5.1.2) because these future states will be (have not yet been) decided jointly by DOE, the US EPA and the Washington Department of Ecology. However, four exposure scenarios were evaluated, effectively evaluating the range of future land use scenarios including small-scale agricultural, residential, industrial, and recreational.	Sensitivity analyses that investigate the consequences of temporally overlapping plumes should be conducted. Discussion of the conditions that cause the reductions in dose (e.g. Fig 4.34(h)) and sensitivity of these results are absent and should be included in the discussion. The extension of the buffer zone to include Gable Mountain pond source must be formally incorporated into the Hanford future land use plans (as the discussion in the report suggests) to allow for this exclusion in the analysis of results. Alternatively cleanup activities at Gable Mountain Pond could be planned to permit its release from radiological control.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.h. The sensitivity or uncertainty analysis considers factors such as alternative land use plans, remedial actions, radionuclide inventories, site and facility characteristics, and transport parameters to provide reasonable estimates of potential doses at the point of assessment for the period of the assessment. The maximum projected dose over the period of the assessment (at least 1000 years) is presented at the point of assessment.	Yes	The agricultural exposure scenario was demonstrated to be the most restrictive of the exposure scenarios. Uncertainty in the radionuclide inventories of the multiple sources and their mobilities are discussed in Section 5.1.2. No specific quantitative analyses are conducted for the inventories and a case is made for the virtual impossibility of making meaningful quantitative sensitivity analyses because of the absence of inventory information. Discussions are presented that conservative overestimation of inventories providing results that are within performance objective make a reasonable bound of actual inventories without quantifying the influence of an uncertain inventory (p. 5.7). The calculated results are interpreted to evaluate meeting the dose constraint and dose limit beyond the buffer zone for 1000 years (Section 5.1). The discussion identified past liquid discharges as the only significant sources for contributing to future doses to individuals assumed in the exposure assessment. The agricultural exposure scenario is identified as providing the highest calculated doses from among the four exposure scenarios considered. However, calculated doses are interpreted as meeting the dose constraint and dose limit starting at the time of site closure (year 2050). Results presented in Figures 4.34 and 4.35 indicate a sharp decrease in dose in the 50 years just prior to the beginning of the period of analysis at site closure. While most of this dose is attributed to tritium and the dose reduction in time is associated with tritium decay, doses from other longer-lived radionuclides (e.g., Tc-99 in Figure 4.34(h)) also decrease sharply to low levels just prior to the period of analysis. Discussion of the conditions that cause these reductions in dose and sensitivity of these results are absent and should be included in the discussion. For example, does the Tc-99 dose decrease quickly because of dispersion or release into the Columbia River? The Gable Mountain pond source was excluded from discussion of results although it is outside the buffer zone and well above calculated dose limits. The extension of the buffer zone to include this source must be formally incorporated into the Hanford future land use plans (as the discussion in the report suggests) to allow for this exclusion in the analysis of results.	

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.2.i. The need for an ALARA assessment as well as the ALARA assessment itself, is demonstrated using a cost-benefit analysis based on the cost of dose-reduction in the exposed population of $1,000 to $10,000 per person-rem averted. [ALARA assessments are not required if the projected individual or collective doses in the exposed population are trivial.]	Yes	There is a brief cost/benefit analysis relating to ALARA, and a number of implicit ALARA considerations have been applied or considered. Over much of the period of analysis, the doses are clearly trivial, and significant expenditures are clearly required to mitigate doses further (see Section 5.3).	No issue.
3.2.2.j. The options analysis considers alternatives which are technically feasible and demonstrated to be effective in reducing doses to the public at the point of assessment over the period of the assessment.	NA	Not applicable. No options analysis was conducted.	No issue.
3.2.2.k. The results of the analysis for the source terms and transport of radionuclides, dose analysis, sensitivity or uncertainty analysis, and options analysis are reasonable representations of the existing knowledge of the site, disposal facility, and contributing sources.	Yes	Based on existing knowledge presented, the results are reasonable with the following caveats: Not all sources were included in the analysis (see criterion 3.2.1.d). Several additional analyses are recommended to be completed to expand the sensitivity analysis (see criterion 3.2.2.b). Discuss of the sharp reduction in dose limits for long-lived radionuclides is limited and, as discussed in criterion 3.2.2.h, should be expanded.	Issue associated with lack of site knowledge (source term components) could impact results. Sensitivity/uncertainty analyses need to be expanded to include other factors such as potential overlapping ground water plumes, vadose zone 1-D model limitations, Columbia River usage as a far term head boundary.
3.2.3 The Composite Analysis Conclusions are Valid and Acceptable			
3.2.3.a. The composite analysis presents conclusions that demonstrate that the long-term performance of the disposal facility and other contributing sources is in accordance with the guidance in the *Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from Department of Energy (DOE) Low-Level Waste Disposal Facilities*.	Yes	With the exception of omitted sources (see criterion 3.2.1.d), the CA conclusions demonstrate that the LLW disposal facilities and other contributing sources are in accordance with guidance.	Omitted sources, see criteria 3.2.1.d.
3.2.3.a.1. For analyses that are less than the dose constraint of 30 mrem/year for the disposal facility and all other contributing sources, the need for an ALARA assessment is presented, and an ALARA assessment is performed if required.	Yes	An ALARA assessment is not needed based on the cost benefit analyses and ALARA assumptions are adequate within the document.	No issues.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.3.a.2. For analyses that exceed the dose constraint but are less than the dose limit of 100 mrem/year, an options analysis is provided which identifies alternatives that could be conducted to reduce the dose to less than the dose constraint. The need for an ALARA assessment is presented, and an ALARA assessment is performed if required.	Yes	Not applicable, results did not exceed the dose limitations.	No issues.
3.2.3.a.3. For analyses that exceed the dose limit of 100 mrem/year, an options analysis is provided which identifies alternatives that should be conducted to reduce the dose to less than the limit. The need for an ALARA assessment is presented, and an ALARA assessment is performed if required.	NA	Not applicable, results did not exceed the dose limitations.	No issues.
3.2.3.b. The conclusions of the composite analysis are derived from the interpretation of the calculated results for the LLW disposal facility and all contributing sources, the sensitivity or uncertainty analysis, and lead to the development of an options analysis if required.	NA	The conclusions of the CA (pages xi-xii) are derived from the interpreted results and sensitivity and uncertainty analysis. The result of the CA is less than 6 mrem/year, thus, an options analysis is not required and was not performed. The conclusion that the exclusive waste management area and buffer zone should be expanded to include Gable Mountain Pond is reasonable and is supported by the analysis. The conclusion that the active and planned low-level radioactive waste disposal facilities will not contribute significantly to the radiation dose to future members of the public is reasonable and is supported by the analysis. However, potentially significant sources of radioactive material and radionuclides have been omitted from the analysis with inadequate justification (criteria 3.2.1.d and 3.2.1.e).	No issues.
3.2.3.c. The conclusions of the composite analysis presented in the interpretation of results and options analysis can be reasonably accomplished at the disposal facility or reasonably implemented to affect the radionuclide contribution to dose from the other contributing sources.	Yes	Radionuclide dose contribution is greatly effected by other contributing factors and not associated with LLW disposal facilities.	There is concern that not all radionuclides and sources were included that may impact the results. Again these are not from LLW disposal facilities.

Table C-1: Composite Analysis for Hanford 200 Area Plateau - 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.2.3.d. The conclusions of the composite analysis address and incorporate any constraints resulting from other DOE programs or from any Federal, state, and local statutes or regulations or agreements that would influence the calculated results or the options analysis.	Yes	With the noted change of including Gable Mountain pond in the boundary/buffer zone in future analyses, the CA addresses programmatic and regulatory constraints in place today.	Changes in the DOE tank clean up plans will greatly effect the CA. Changes in the US Ecology site waste acceptance criteria or regulatory changes could have a minor effect on the CA results. These changes could be reflected in future iterations of the document.
3.2.3.e. The analysis, results, and conclusions of the composite analysis provide a reasonable representation of the disposal facility and other contributing sources for determining the appropriate actions to be taken for the protection of public health and environment. The analysis and results of the composite analysis are consistent with comparable results of the performance assessment and provide a defensible and complete basis for an acceptable decision by DOE.	Yes	The CA is a reasonable representation of the site, though some additions mentioned previously would improve the document. Comparison with the ILAW, 200E and 200W PA's and ERDF assessment is difficult due to usage of different modeling tools, assumptions, and time frames used for analysis. With the exception of excluded sources (see criterion 3.2.1.d) and the lack of evidence that the assumed performance of the ILAW glass waste form can actually be attained, the CA provides a defensible and complete basis for an acceptable decision by DOE.	Previously mentioned improvements include (but not limited to): Inclusion of Gable Mountain pond in buffer zone, decision on future site usage, inclusion of chemical plant and Purex tunnels in source terms, expansion of radionuclides discussed to include U daughters, I, Se, Tc consistently in the document. Consistency in estimation of other site factors-ERDF source term overestimated, US Ecology source term underestimated. Explanation of all radionuclides decay products analyses. Sensitivity analysis to include scenarios covering vadose zone 1-D modeling; Kd changes below the tanks; addition of redox potentials as discriminators; Columbia River as a head boundary in the far term; potential overlapping groundwater plumes.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1 PA is Complete			
3.1.1.a. PA identifies the performance measures used in the PA and a justification of those performance measures as site-specific applications of the performance objectives.	Yes	Performance Measures are defined and reasonably justified in Section 1.6. The performance objective of 25 mrem/year was adopted as a performance measure. The location for compliance is the point of maximum exposure outside a 100-meter buffer zone surrounding the waste. The requirement to assess exposure to a hypothetical inadvertent intruder used the performance measures of 100 mrem/year for chronic exposure and 500 mrem for acute exposure. The time for compliance with these performance measures was taken to be 500 years after facility closure. This time, rather than the default time of 100 years, was justified on the basis of passive barriers and markers. The performance objective to protect water resources was interpreted to require protection of groundwater and surface water. For groundwater protection, the performance measure adopted was that concentrations of contaminants in groundwater not exceed Federal standards for drinking water. Thus, a dose of 4 mrem/year for beta/photon emitters and a concentration of 15 pCi/L for alpha emitters (including uranium) were used. These performance measures were applied to a hypothetical well located 100-meters down gradient from the disposal facility. For surface water, a performance measure of 1 mrem/year was adopted to be consistent with Washington State requirements. The point of compliance for surface water protection was assumed to be the point at which groundwater enters the Columbia river. The performance objective to restrict exposure of any member of the public to no more than 10 mrem/year via the air pathway was adopted as a performance measure. The performance objective to restrict emissions of radon to no more than 20 pCi/m^2s was also adopted as a performance measure.	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.b. PA presents information on the site geography, demography, land use plans, meteorology, ecology, geology, seismology, volcanology, surface water and groundwater hydrology, geochemistry, geologic resources, water resources, and natural background radiation sufficient to support the analysis presented in the performance assessment.	Yes	The PA presents information on the site geography, demography, land use plans, meteorology, ecology, and regional geology, geochemistry, seismology, volcanology, surface water and ground water resources, and natural background to the reasonable extent necessary. The general discussion on the near-field subsurface geology also seems reasonable; however more details should be presented in the PA. Borehole logs and well completion drawings of the three boreholes (Fig. 2-13) should present more details of the material types, geology, and subsurface hydrology. Tables should be included that list pertinent boreholes and monitor wells with total depth, top of casing, etc. Figure 2-10 poorly represents borehole locations. Consider using: a fold-out plate map, identify latitude and longitude coordinate system, and fence diagram to illustrate geology in area of disposal.	Need better traceability for many details and basic summaries of reference material. Note: Hanford disagreed with this comment based on the need for textual economy.
3.1.1.c. PA presents information on the facility design features including elements of the design that address water infiltration disposal unit cover integrity, structural stability, and the inadvertent intruder barrier sufficient to support the analysis presented in the PA.	Yes	Section 2.4 describes the disposal technology. This section includes details of disposal vault construction, both for the existing vaults and for the additional vaults that will be constructed. Sections 2.4.1.4 and 2.4.1.5 discuss closure of the disposal units and the site. These sections discuss features of the closure designed to limit infiltration and those features that deter intrusion. The information presented is sufficient to support the analyses. However, the depiction of the cover design is confusing regarding the slope of the cover. The relationship of cover performance to potential contaminant transport in the vadose zone is not presented clearly. A no-slope cover could create greater deep percolation over the life of disposal. The cover design should consider ALARA concepts (sloping top cover to drain sheet flow in the event of 1000 year precipitation event).	Details regarding cover design are confusing. However, we recognize that conceptual designs were published after issuance of the PA.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.d. PA identifies Federal, state, and local statutes or regulations or agreements that impact site engineering, facility design, facility operations, and the relationship and/or impact of the results of the PA on site engineering, facility design, or facility operations because of these factors.	Yes	In Sections 1.5 and 1.6 all potentially applicable statutes, regulations or agreements are identified. In Section 1.5.2, *the Federal Facility Agreement and Consent Order* is discussed. Some of the legally enforceable milestones cover the Immobilized Waste Program. In Section 1.6.2.2, the *NRC Branch Technical Position on a Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities* is discussed. This document is pertinent because it lays out NRC PA requirements, namely the time of compliance which is 10,000 years. Hanford has adopted the longer time of compliance in order to fully comply with the Incidental Waste requirements of DOE 435.1. In Section 1.6.2.5, Federal and State requirements for drinking water are discussed and applied to the protection of groundwater resources. In Section 1.6.2.6, Federal and State requirements for surface water protection are discussed and applied to the ILAW PA. In Section 1.6.2.7, Federal and State requirements for air emission limits are discussed and applied to the ILAW PA. Section 2.4.1.1 discusses the RCRA design requirement for double containment under which the existing vaults were constructed.	No issues.
3.1.1.e. PA identifies procedures and facility related documentation that may impact site engineering, facility design, or facility operations and the relationship and/or impact of the results of the performance assessment on the documents and site engineering, facility design, or facility operations.	Yes	The PA, in Sections 2.3 and 2.4 identifies documentation (e.g., TWRS record of decision, privatization specifications for immobilization) that may impact the site/facility. However, no evidence is provided that the assumed glass performance can actually be achieved.	No indication is provided that assumed glass performance can be achieved. However, supplemental information provided by Hanford (see Appendix F) mitigated this issue.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.f. PA identifies and justifies key assumptions included in the analysis presented in the PA.	Yes	The PA identifies the key assumptions to be: 1) Inventory assumption that average values from modeling, corrected for credits, seems reasonable and justifiable. 2) Waste form performance assumption that short-term performance and long-term performance are equal is not justifiable without further information. No evidence is presented that the assumed glass performance can actually be achieved. 3) Disposal design, geotechnical considerations, and dose calculation assumptions seem reasonable and justifiable. 4) Recharge relationship to potential contaminant release assumptions needs more explanation in the next iteration of the PA.	1)No issues. 2) Issue is being addressed by Hanford's additional research activities. 3) No issues. 4) Hanford agrees that future Pa revisions will include these effects.
3.1.1.g. PA identifies the point of assessment for each performance measure, and justifies the selection of each point of assessment. *3.1.1.g.1.* The point of assessment for all-pathways, the air pathway excluding radon, and groundwater resource protection is justified based on future land use. If the future site boundary is uncertain, a reasonable point of assessment (e.g., point of maximum impact greater than 100-m from the edge of the disposal unit) is justified.	Yes	The PA, in Section 1.6.2.2 identifies the point of assessment for the all-pathways performance objective as being at the point of maximum exposure, but not less than 100-meters from the disposal facility. The 100-m well is also used for the groundwater protection performance objective as stated in section 1.6.2.5. The point of assessment is conservatively assumed to be the point of maximum exposure outside the 100-m buffer zone for the all pathways, air pathway (excluding radon), and the groundwater protection performance objectives.	No issues.
3.1.1.g.2. The default point of assessment for the performance measure for radon exposure that is based on a limit on the average flux of radon of 20 $pCi/m^2/s$ at the ground surface is the ground surface over the disposal unit.	Yes	The performance assessment demonstrates that radon fluxes will be below 20 $pCi/m^2/s$ at the ground surface over the disposal unit. The calculations use appropriate models and assumptions. The deep burial of the waste significantly reduces the small amount of radon present by decay as a consequence of the short half life of radon. The analysis should state that the inventory does not contain sufficient radon precursors to generate significant radon during the time period of analysis. [See Table ES-6; Table 6-5; page 4-74 *et seq.*] Consequently, while the discussion could be improved, the analysis is complete for review purposes even in light of this oversight.	No issues.
3.1.1.g.3. The default point of assessment for the alternative performance measure for radon exposure that is based on a limit on air concentration of radioactive material of 0.5 pCi/L is 100-m from the edge of the disposal unit.	Yes	The default performance measure of 20 pCi/m^2s is used, thus, this criterion is not applicable	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.h. The performance assessment identifies and quantifies all radionuclides present in the low-level waste to be disposed of at the facility that could significantly contribute to dose for the all pathways analysis, the air pathway analysis, the groundwater analysis, and the intruder analysis. Technical justification is provided for those radionuclides considered in detail in the analyses, and conversely, those not considered in the analyses.	Yes	In Section 3.2.1, the radionuclides relevant to the PA are identified by means of a reasonable screening analysis. All radionuclides produced at Hanford were considered. The inventory of potentially important radionuclides, Section 3.2.2, was developed from generally reasonable assumptions regarding radionuclide production in reactors and partitioning in chemical processing and in the waste tanks. However, the estimate of ^{99}Tc inventory appears to be considerably over stated (see detailed comments by H. Babad).	The Tc-99 inventory appears to be considerably overstated.
3.1.1.i. PA accounts for all relevant mechanisms for the release of radionuclides from the waste materials for environmental transport. The mechanisms analyzed are justified by references to relevant studies, available data, or supporting analyses in the PA.	No	The performance assessment presents a base case using a simplified model because the waste form had not been determined and only specifications for its short-term release rate are known (p. 3-8).The base case assumed the glass waste form released contaminants at a rate equivalent to the TWRS privatization RFP specification of $1.4x10^{-13}$ s^{-1} (p.3-39). It was assumed that this rate remained constant over time (however, the dimensions of the waste form decreased at a constant rate). Initially, the waste form was assumed to be a non-fractured monolith with dimensions of 1.2 x. 1.2 x. 1.8 m. No justification for the appropriateness of this assumption was provided. The preparers should have reviewed available data on glass leaching to put the assumed rate of glass corrosion into perspective. The contaminant release rates were independent of the infiltration rates used in the sensitivity study. This makes the infiltration sensitivity results less informative. The PA should discuss the vadose moisture relationship to contaminant release rate.	No evidence has been presented that the modeled performance has any relation to the actual performance which may reasonably be expected. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F). Need discussion of the relationship between vadose moisture and contaminant release rate.
3.1.1.j. PA provides a complete and clear description of the conceptual model of the environmental transport of the radionuclides from the waste materials to the points of compliance by air and water. The conceptual model is justified by referenced investigations, data, and supporting analyses that are representative of the site-specific conditions described.	Yes	With one exception, the conceptual model for the ground water pathway is complete, clearly described, and justified. See criterion 3.1.1.b for suggestions. The exception is the rate of contaminant release from the glass waste form. The specification in the privatization contract for waste immobilization is the short-term glass corrosion rate. No evidence is provided that the assumed rate can be achieved. The conceptual model for the air pathway is complete, clearly described, and justified.	Lack of evidence that assumed glass waste form performance can be achieved. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.j.1. The conceptual model incorporates interpretations of available geochemical, geologic, meteorologic and hydrologic data, and the relevant mechanisms that have a significant effect on the transport of radionuclides at the disposal site.	Yes	Relevant mechanisms, supported by reasonable interpretations of available data are incorporated in the conceptual model for the air pathway. In general, the use of only two soil types in the vadose-zone model prevents evaluations of heterogeneities such as uncased, lost boreholes or preferential flow paths. The PA should more thoroughly present information on recharge rates and the relationship to contaminant concentrations and flux. The conceptual model for the base case does not incorporate mechanisms of glass corrosion. Rather, an assumed corrosion rate is used with no evidence provided to indicate whether the corrosion rate can actually be achieved.	Unsupported glass corrosion rate. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.1.j.2. Assumptions incorporated into the conceptual model to account for transport mechanisms lacking sufficient data or supporting analyses are identified and justified as reasonable representations of site behavior over the time period considered in the analysis.	No	Performance of glass waste form is assumed with no evidence that the assumption is credible.	No assurance that assumed glass performance can actually be achieved.Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.1.j.3. The conceptual model includes closure of the facility as justified based on referenced closure plans or reasonable assumptions of facility closure.	Yes	The conceptual model includes reasonable assumptions for facility closure. However, it is not clear exactly which closure design will be used (see pp. ES-xviii and 6.1). We recognize that conceptual designs were completed after completion of the PA.	No issues.
3.1.1.j.4. The conceptual model includes any credits to be taken in the analysis for the performance of engineered features. Credits for engineered features include a reasonable representation of the degradation of the engineered features that is justified by supporting investigations and data.	Yes	The analysis takes credit for the Hanford barrier to reduce infiltration. Increasing the infiltration rate to the natural rate after the first 1,000 years (the design life of the barrier) incorporated degradation of the barrier. A sensitivity case that used the natural recharge rate for the entire time provided information on the effect of a shorter life for the barrier than the design life. The analysis did not take credit for the waste packages. This is at least somewhat conservative. The analysis may be very conservative from the viewpoint that the waste containers will certainly be made of some sort of steel. Steel corrosion products are likely to be good at sorbing at least some radionuclides. This could have been investigated in a sensitivity case. The analysis takes credit for the concrete vaults, but only for 500 years. This is likely conservative. Sensitivity analyses were done with no credit for the vaults and with longer credit (i.e., 2,000 years) for the vaults.	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.j.5. The conceptual model includes natural processes that affect the transport of radionuclides (e.g., flooding, mass wasting, erosion, weathering) over the time period considered in the analysis, as justified based on referenced investigations and supporting analysis.	Yes	The conceptual model includes relevant natural processes and is consistent with other site PAs.	No issues.
3.1.1.k. PA provides a clear description of the mathematical models used in the analyses. The mathematical models selected are justified and provide a reasonable representation of all of the elements of the conceptual model.	Yes	More clarification would add value to the analysis. For example, more information is required to describe the unit cell model used in some sensitivity analyses. What code is used (e.g., PORFLOW)? How many elements are used? What specific comparisons were made to the disposal facility model (e.g., moisture content, radionuclide transport, etc.) to ensure that these models are consistent?	Need additional information on unit cell model.
3.1.1.k.1. The complexity of the mathematical models selected is commensurate with the available site data.	Yes	Mathematical models/computer code (AREST-CT for source release, PORFLOW for unsaturated zone, and VAM3D-CG for unsaturated flow and results) selections are commensurate with available data. Although, an observation regarding the difficulties and confusion due to many codes and models utilized in this PA, and to the non-integrated selection methodology to the codes/models in the CA (and other DOE disposal facilities) may lead to major inefficiencies.	No issues.
3.1.1.k.2. Assumptions incorporated into the mathematical models are identified, justified, and consistent with the conceptual model	Yes	Assumptions are identified, justified, and consistent with the conceptual model.	No issues.
3.1.1.k.3. Mathematical models selected are documented and verified either in referenced publications or in the appendices of the performance assessment	Yes	Models are well documented.	No issues.
3.1.1.l. PA provides a complete description of the important exposure pathways and scenarios for the specific disposal facility that are used in the evaluation of the potential doses to the hypothetical, individual member of the public and inadvertent intruder consistent with site-specific environmental conditions and local and regional practices. The exposure pathways and scenarios selected for detailed analysis are justified as conservative representations of the long-term performance of the LLW disposal facility.	Yes	The PA provides a sufficiently complete description of pathways and scenarios (Section 3.3). With the exception of glass performance (see criterion 3.1.2.b), pathways and scenarios are reasonable and conservative representations of long-term performance.	Insufficient justification for assumed glass performance. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.l.1. Exposure pathways from the transport of contamination in groundwater that may be considered include potential exposures from the ingestion of contaminated groundwater, the use of contaminated groundwater for irrigation and livestock watering, and the biotic uptake and transport of contamination from groundwater and surface water. Potential exposure pathways from the transport of contamination in surface water include the ingestion of contaminated surface water and contaminated fish.	Yes	The exposure pathways from the transport of contamination in groundwater (Section 3.3.5) and include ingestion of contaminated groundwater, use of contaminated groundwater for irrigation of a small farm. Exposure comes from drinking contaminated water, ingesting contaminated food grown on the farm, ingesting and inhaling contaminated soil, and direct irradiation from the contaminated soil. Because the performance measure for surface water protection is a dose, assuming consumption of the surface water (Section 1.6.2.6), ingestion of contaminated fish was not considered.	No issues.
3.1.1.l.2. If radiation dose is used as a measure of groundwater resource protection, the exposure scenarios consider the ingestion of water (at 2 liters per day or an alternative rate, if a justification is included) at the point of assessment, which represents the location of maximum exposure from a well constructed and developed using current practices typical for the local area	Yes	The groundwater protection scenario used a consumption rate of 2 L/day and assumed the well would be located to provide the maximum dose outside the 100-m buffer zone. Based on characterizations at numerous uranium mill tailings sites where inorganic contaminants were released decades ago and migrated into ground water, often in silty/sandy/gravely environments not unlike Hanford; vertical distribution of contaminant	No issues.
3.1.1.l.3. Exposure scenarios from the transport of contamination in water for the all pathways analysis considers the use of groundwater and surface water consistent with local and regional practices. Exposure scenarios that may be considered include drinking water, crop irrigation and livestock watering, the ingestion of dairy products, livestock, fish, crops, and soil, the inhalation of resuspended particles, and external exposure.	Yes	The all pathways analysis considered groundwater uses consistent with local and regional practices. Exposure pathways (Section 3.3.4) include drinking contaminated water, ingesting contaminated food, ingesting and inhaling contaminated soil, and direct irradiation from the contaminated soil. The exposure pathways and scenarios are consistent with other Hanford performance assessments.	No issues.
3.1.1.l.4. Exposure pathways from the transport of contamination in the atmosphere that may be considered include potential exposure from immersion in air contaminated with volatile and nonvolatile radionuclides, deposition of volatile and nonvolatile radionuclides, and subsequent exposure from direct radiation, ingestion, and resuspension.	Yes	The analysis of potential exposure from the air pathway (Section 4.12) considered a limited set of radionuclides (^{3}H, ^{14}C, and ^{222}Rn) and a limited set of exposure pathways (inhalation and immersion). These assumptions are reasonable and are consistent with other Hanford PAs.	No issues.
3.1.1.l.5. Exposure scenarios from the transport of contamination in air that may be considered include residential and gardening activities which include the direct inhalation of volatile and nonvolatile radionuclides, external exposure, ingestion of crops, soil, livestock, dairy products, and inhalation of resuspended particles.	Yes	Exposure scenarios for the transport of contamination in air are discussed in Section 4.12. Based on past performance assessments at Hanford, the analysis of airborne contamination is limited to three radionuclides (^{3}H, ^{14}C, and ^{222}Rn). The scenarios include inhalation and immersion in contaminated air.	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.l.6. Exposure pathways from inadvertent intrusion into the waste disposal units identify the chronic and acute exposure pathways for each of the exposure scenarios considered. The exposure pathways include all relevant ingestion, external exposure, and inhalation pathways for each exposure scenario. [Direct ingestion of contaminated groundwater and exposures to radon should not be considered for inadvertent intrusion, because they are considered separately.]	Yes	The analysis of inadvertent intrusion (Section 5) identified the chronic and acute exposure pathways considered in the exposure scenarios. The chronic scenario was the homesteader scenario while for acute exposure, the well driller scenario was used. The exposure scenarios include all relevant pathways; direct ingestion of contaminated groundwater and exposures to radon are not considered.	
3.1.1.l.7. Acute exposure scenarios for inadvertent intrusion considers direct intrusion into the disposal site and exhumation of accessible waste material. Relevant scenarios that may be considered include discovery, residential construction, and well drilling that incorporate external exposure, inhalation of resuspended particles, and ingestion of particles.	Yes	The acute scenario considered well drilling, direct intrusion into the disposal site and the exhumation of waste. The analysis properly rejected consideration of construction scenarios based on the depth of disposed waste. The drilling scenario analyzed included external exposure, inhalation of resuspended particles, and ingestion of particles.	No issues.
3.1.1.l.8. Chronic exposure scenarios for inadvertent intrusion consider direct intrusion into the disposal site and exhumation of accessible waste material. Relevant scenarios that may be considered include residential use and post-construction, and post drilling agricultural use, that incorporate the ingestion of foodstuffs, ingestion of soil, external exposure, and inhalation of resuspended particles.	Yes	The chronic exposure scenario considered, the homesteader scenario (Section 5.2), includes direct intrusion into the disposal site and exhumation of waste. This scenario properly considered removal of waste by drilling rather than construction. The analysis included all relevant pathways and is consistent with other Hanford performance assessments.	No issues.
3.1.1.m. PA provides a coherent presentation of the relevant descriptive information concerning the site, the disposal facility, the waste characteristics that are reflected in the conceptual model, and the selection of the mathematical models used in the analysis. The descriptive information and the approach to modeling provide the necessary results to evaluate the exposure pathways and scenarios that are important to assess the performance of the disposal facility.	Yes	The description of the site, disposal facility, waste characteristics, and mathematical models are presented in a complete and coherent manner. The results are presented in a complete manner. However, no supporting information is provided to indicate that the assumed glass performance can actually be achieved.	No evidence that assumed glass performances can be expected to be achieved. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.1.n. The calculated results presented in the PA are consistent with the site characteristics, the waste characteristics, and the conceptual model of the facility. The demonstration of consistency is supported by available site monitoring data and supporting field investigations.	Yes	The calculated results are presented in a thorough and complete manner. (See sections 3, 4, and 5. The results are generally consistent with site and waste characteristics. However, no evidence is provided that the long term performance of the glass waste form can actually be achieved.	Insufficient justification for assumed glass performance. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.o. The models used for calculating the results presented in the PA are analyzed to identify the sensitive parameters in the analysis. The results of the sensitivity analysis are used to evaluate the uncertainty in the calculated results.	No	A deterministic base case was performed with a number of sensitivity analyses performed on a sub-system level (e.g., vadose-zone transport). However, some of the sensitivity analyses were performed with a different sub-system model (e.g., unit-cell model instead of the disposal facility model). The lack of consistency raises concern over the results and conclusions of the sensitivity analyses. No information was presented to relate the results of the unit cell model with the disposal facility model.	Lack of modeling consistency raises concern over the results and conclusions of the sensitivity analyses. In the factual accuracy review of the draft Review Team Report, Hanford disagreed with this comment.
3.1.1.p. The results of the uncertainty analysis are interpreted as they relate to establishing reasonable assurance that the conclusions of the PA are correct.	Yes	The results of the uncertainty analysis are used in relation to reasonable assurance that conclusions are correct. However, no information is presented to indicate the assumed glass corrosion rate can actually be achieved.	Need assurance that assumed glass corrosion rates can actually be achieved. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.1.q. The PA integrates the results of the analysis, the uncertainty analysis, the performance measures, waste acceptance criteria, operating procedures, and applicable laws, regulations, policies and agreements to formulate conclusions.	No	The PA integrates the results of the analysis, the uncertainty analysis, the performance measures, etc. to formulate conclusions. However, the conclusions of the PA regarding compliance with the groundwater protection performance objective is not supported because no evidence is provided that the assumed glass waste form performance can actually be achieved.	No support for assumed glass waste form performance. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.1.r. The PA includes an interpretation of the results that allows for a comparison to the performance measures used in the PA, and include any necessary limitations on facility design or operations that are required to meet the performance objectives.	Yes	The PA includes an interpretation of results compared to the Performance Objectives stated in Section 1.6. Section 6.3 discusses the requirements set by the results. Each performance objective discussion included the estimated impact compared to the base objective. Most discussions also included a list of key drivers or conditions that could affect the results.	No issues.
3.1.1.s. The PA discusses quality assurance measures applied to the preparation of the analysis and its documentation.	Yes	The description of quality assurance programs (Section 7) includes an overview description of the quality programs at various organizations that are involved in the ILAW project. In addition, the Hanford Environmental Dose Overview Panel reviewing approved dose calculations presented in the PA. Consequently, the discussion of quality programs is deemed complete.	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.1.t. The PA includes an ALARA analysis, and if appropriate, the analytical methods for the ALARA assessment are described.	No	There is a minimal description of ALARA and similar activities in Section 4.11.	No issues.
3.1.1.u. The PA included appendices or references to published documents and/or data that provide a basis for the discussions and analysis in the PA.	Yes	The appendices and references are complete to a fault. (See Section 9 and Appendices A-H).There is entirely too much reliance throughout the document on the references. For example, the general discussion on subsurface geology seems reasonable, however, details are vague. More traceable details should be present such as borehole logs and well completion drawings of the three new bore holes. Tables should be included that list pertinent boreholes and monitor wells with depth, toc, etc. Figure 2-10 poorly represents borehole locations. Consider using: a fold-out plate map, identify latitude and longitude coordinate system, fence diagram to illustrate geology in area of disposal.	Vagueness in the document as a result of over-reliance on reference material for important data that should be summarized in PA. In the factual accuracy review of the draft review team report, Hanford disagreed with this comment.
3.1.2. PA is Thorough and Technically Supported			
3.1.2.a. The PA presents an estimate of the radionuclide inventory of the radioactive waste disposed of and to be disposed of at the facility which is quantified and technically supported by records, data, studies and evaluations.	Yes	The waste being considered in this PA is from the Hanford high-level waste tanks. The waste was produced from chemical separation of fuel and target elements irradiated in the Hanford reactors. The inventory first considered all radionuclides produced at Hanford. Then, a simple and defensible screening methodology was employed to determine the most important radionuclides from the perspective of doses calculated in a PA. The resulting set of important radionuclides (p. 3-2) is consistent with previous Hanford PAs (i.e., those for the 200-E and 200-W burial grounds). The inventory of potentially important radionuclides was developed from generally reasonable assumptions regarding radionuclide production in reactors and partitioning in chemical processing and in the waste tanks. However, the estimate of ^{99}Tc inventory is likely to be considerably over stated (see detailed comments by H. Babad in Appendix).	No issues.
3.1.2.a.1. All of the radionuclides disposed and anticipated to be present in wastes to be disposed of are evaluated in the performance assessment. Any radionuclides screened from detailed analysis or having no inventory limit are identified, and the bases for these conclusions are supported and defensible	Yes	Same as Section 3.1.2.a response.	Same as Section 3.1.2.a issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.a.2. Any estimates of the radionuclide inventory for past waste disposals are described and to the extent practical are based on past waste disposal records, a reasonable expectation of actual waste content based on a knowledge of the processes that generated the waste, calculations, sampling data, technical studies, and reasonable projections of waste to be disposed	Yes	Same as Section 3.1.2.a response..	Same as Section 3.1.2.a issues.
3.1.2.b. The physical and chemical characteristics of the waste disposed of in the past that affect the release and transport of radionuclides are identified. The physical and chemical characteristics of the waste form are quantified and supported by laboratory or field studies, or are based on referenced documentation.	No	The physical and chemical characteristics of the waste form were not quantified and do not seem to be supported by laboratory or field studies or referenced documentation. The base case simply assumed the glass waste form released contaminants at a rate equivalent to the TWRS privatization RFP specification of 1.4×10^{-13} s^{-1} (p.3-39). It was assumed that this rate remained constant over time (however, the dimensions of the waste form decreased at a constant rate). Initially, the waste form was assumed to be a non-fractured monolithic 1.2 x. 1.2 x. 1.8 m cube. No justification for the appropriateness of this assumption was provided. The preparers should have reviewed available data on glass leaching to put the assumed rate of glass corrosion into perspective. However, no attempt was made to relate the composition or properties of this glass with the glass that will be disposed in this disposal facility. The physical characteristics of the waste were taken into account in the release model, but it is not clear that they were conservatively simulated. The base case assumes that the glass is a monolith in the form of a cube (dimensions given above). A sensitivity case was analyzed where the waste form has the shape of a thin plate. The actual physical form of the waste will be highly dependent on conditions associated with pouring the glass into the container and handling of the filled containers. The glass may crack extensively. It is not clear that the cases analyzed bound the performance of an extensively cracked waste form. Sensitivity analyses consider a more mechanistic basis for performance of the waste form, assumed to be glass. Section 3.3.3 (page 3-20) contains a brief discussion of a scenario that would lead to release of radionuclides from a glass waste form. However, this scenario is not used in the analysis. Getter material (page 3-41) and waste conditioning layers (page 3-42) are mentioned but not used in the analysis.	The PA is only valid if the privatized contractor can demonstrate that the specified release rate can be met for both short and long time frames. There is no discussion of this aspect contained in the PA. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.b. (continued) The physical and chemical characteristics of the waste disposed of in the past that affect the release and transport of radionuclides are identified. The physical and chemical characteristics of the waste form are quantified and supported by laboratory or field studies, or are based on referenced documentation.	No	Statements throughout the PA make clear that how release rate is controlled (i.e., the selection of waste forms and their performance) is the responsibility of the privatized contractor. Based on discussions with the PA analysts during the first Hanford site visit, the review team understood that the specific release rates in the waste form specification were derived from simple estimates of required disposal facility performance and not from capabilities of any specific waste forms. If this is true, then the base case analysis included in the PA does nothing more than confirm that the release rate selected for the contract specification was sufficiently small as to limit future doses to acceptable limits. This obviously circular argument leads to misleading statements, such as the one on page ES-ix. However, the authors recognize that more analysis must be done, as stated on page ES-xvii: The PA must show that these restrictions [e.g., release rates from waste forms] can be expected to be met. This task is attempted through the use of more mechanistic models contained in the sensitivity analyses. Some concerns related to the base case analysis include: The size assumed for the cubical waste form (page 3-42); The basis of equation 3.8 and its relationship to a cubic waste form (page 3-40; Basis for determining constant K4 (page 3-40); Basis for T=6.8E5 years (page 3-41); Concerns related to the sensitivity analysis include: Justification for spheres used as a waste form and their sizes (page C-3); Basis and justification for the release rate used in ARREST-CT (equation C.9); Basis and justification for the list of reactions used in the analysis (Table C.1); sensitivity analysis details that the fractional release rate will be met.	Same as Section 3.1.2.b. issues.
3.1.2.b. (continued) The physical and chemical characteristics of the waste disposed of in the past that affect the release and transport of radionuclides are identified. The physical and chemical characteristics of the waste form are quantified and supported by laboratory or field studies, or are based on referenced documentation.	No	In Appendix E (page E-42), a discussion is made claiming that use of computer models identified effects not seen in the laboratory (i.e., effects of ion exchange on pH). General concern that the model is giving correct information if it is not based on data derived from experimental sources. As a demonstration that the contract specification can be met, the PA is insufficient.	Same as Section 3.1.2.b. issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.c. Any inventory limits are developed from reasonable projections of waste to be disposed and analyses that consider the physical and chemical characteristics of the wastes if those characteristics affect the release and transport of the radionuclides.	No	Generally, the PA has identified significant parameters and has developed requirements for the facility and waste based on the analyses presented. Waste Acceptance Criteria (WAC) were developed from the analyses presented in the PA. However, as noted in criteria 3.1.1.i and 3.1.2.b, the assumed release rate of radionuclides from the glass waste form was that in the contract specification. No attempt was made to relate this assumed release rate to expected glass performance. In the analysis of compliance, the performance of glass LD6-5412 was assumed. There was no discussion of the performance of this glass in relation to that of glass expected to be produced.	No evidence is provided that the assumed glass waste form performance can be achieved. Thus, no assurance can be provided that performance objectives can reasonably be expected to not be exceeded. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.2.d. The conceptual model is a reasonable interpretation of the existing geochemical geologic, meteorologic, hydrologic, and monitoring data for the site and disposal facility. The components of the conceptual model for the transport of radionuclides that are important to the conclusions relating to the long-term performance of the disposal facility are thoroughly analyzed. The assumptions incorporated into the conceptual model are consistent with the available data, related investigations, and theory related to the conceptual model. Any parameters included in the conceptual model are supported by data or related investigations relevant to the site and disposal facility.	Yes	Geochemical data is adequate (Table 3-8) and has adequate technical support. The sensitivity of this parameter has been adequately investigated for key radionuclides (e.g., page 4-50 *et seq.*). The geochemical data in the base case is adequately supported by data and investigations at the site, with appropriate references. The most mobile radionuclides (Sc, Tc) have been assigned a KD of O. Other radionuclides (U,I,C,S, and others) are assigned Kds less than 10 and at the bottom of the measured range for Hanford vadose zone soils. The sensitivity analysis examined both slight increases in the Kd for Se ad Tc and a decrease in the U and I Kd to zero. The sensitivity analysis for this parameter for these elements demonstrated that the dose from groundwater at 10,000 years is very dependent on this parameter for these elements. Finally, the long travel time of radionuclides in the groundwater results in significant radioactive decay of radionuclides with half lives less than 100 years. A table identifying calibration targets for recharge and head distributions for selected grids would be beneficial to the reader to better understand water balance, and observed vs. predicted fits.	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.e. The assumptions of the performance assessment related to the waste, site, and facility design and operations which are critical to the conclusions of the performance assessment are supported and the uncertainties associated with these assumptions are analyzed as part of the performance assessment. Credits for the performance of engineered features and site closure included in the conceptual model are based on data derived from field investigations, related investigations, or documented sources of information relevant to the site and disposal facility.	No	Assumptions related to the performance of the site and the facility are supported and uncertainties are analyzed. Credits for engineered features, including site closure, are derived from field investigations and other documented sources. However, as noted in criteria 3.1.1.i and 3.1.2.b, the assumed radionuclide release rate from the glass waste form is simply the contract specification for short-term release. There is no discussion of the relation of the assumed release rate and observed release rates of glass waste forms.	Noted in criteria 3.1.1.i and 3.1.2.b, the assumed radionuclide release rate from the glass waste form is simply the contract specification for short-term release. There is no discussion of the relation of the assumed release rate and observed release rates of glass waste forms. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.2.f. The conceptual model for the source term, groundwater flow, and radionuclide transport includes parameters for unsaturated and saturated flow, total and effective porosity, hydraulic conductivity, water retention, relative permeability relationships, volumetric water content, retardation, and diffusion that are based on data, related investigations, or documented references relevant to the site and disposal facility.	Yes	The vadose-zone parameters provided in Table 3-6 (p. 3-30) need further justification as to how they were obtained from Khaleel (1995). Were these parameters averaged over different soil types? See Section 3.1.2.d for geochemical discussions.	
3.1.2.g. The mathematical models used in the performance assessment for analyzing air and water transport of radionuclides are appropriate for the disposal facility and disposal site. The selected models provide a justified representation of the technically important mechanisms identified in the conceptual model, and provide calculated results that are a defensible basis for formulating conclusions.	Yes	Models used for the air pathways are appropriate and are consistent with the other Hanford performance assessments. PA should provide text on how radionuclide concentrations are transferred between the vadose and aquifer models. PA should consider that if the grid sizes are different, artificial dilution is occurring between the unsaturated- and saturated-zones.	Issues related to vadose zone modeling and interface between vadose and saturated zone matrix.
3.1.2.g.1. The input data for the mathematical models are derived from field data from the site, laboratory data interpreted for field applications, or referenced literature sources which are applicable to the site. Assumptions which are used to formulate input data are justified and have a defensible technical basis.	Yes	The units on equations ES.3 & ES.4 (p. ES xv) are not consistent.	

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.g.2. Intermediate calculations are performed and results are presented that demonstrate, by comparison to site data or related investigations, the calculations of the mathematical models used in the performance assessment are representative of disposal site and facility behavior for important mechanisms represented in the mathematical models	Yes	The air pathway model is sufficiently simple that presentation of intermediate results is not appropriate. The unit cell model was used as a surrogate for the disposal facility model in many of the sensitivity analyses. However, there were no intermediate calculations to demonstrate that this simplified model correlates well with the disposal facility model. Therefore, sensitivity analyses may be providing results that are not consistent with the base case.	Correlation of unit cell model and disposal facility model is required to demonstrate that the sensitivity analyses are representative relative to the base case.
3.1.2.g.3. Representations of groundwater well performance (e.g., construction, diameter, yield, depth of penetration, screen length) are reasonable reflections of regional practices and are justified.	No	Well completions might not be ideally suited to 3-d modeling. This potential data gap should be considered in future PA iterations.	
3.1.2.g.4. The mathematical models are tested, by comparison to analytical calculations or other models, to demonstrate that the results are consistent with the conceptual model, physical and chemical processes represented in the models, and available site data. The models are evaluated for defensibility and are reasonable representations of the disposal site and facility performance by comparison to available site data, related technical investigations, or referenced documentation or literature.	Yes	The verification of mathematical models is discussed in Section 3.5. Models were verified versus other codes, analytical solutions, or site data, as appropriate. However, some questions regarding fundamental modeling assumptions remain. They are: Are vadose-zone moisture contents and water fluxes simulated at steady-state? If not, what are the initial conditions? If they are not steady, as the text seems to indicate, then how can the transport equations given in Eq. D.6 (p. D-3), which are based on steady-state flow, be used?	No issues.
3.1.2.g.5. The initial conditions, the boundary conditions, and the changes of properties with time for the mathematical model are analytically correct (i.e., well posed), and derived from existing site data and information.	Yes	Boundary conditions of pumping model are taken from site-wide model, but these boundary conditions will change based on pumping rates used in the pumping model. Other boundary conditions are identified and reasonable.	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.h. The dose analysis considers the exposure pathways and transfer factors and calculates the maximum dose using acceptable methodologies and parameters.	Yes	The dose analysis considers exposure pathways and transfer factors using acceptable methodologies. The dose analysis of radionuclides uses transfer coefficients that are well supported by data and references. (See Appendix B and Section 5) The dose analysis specifies consumption rates, inhalation rates, and external exposure rates (i.e., occupancy) and conditions. The sources of these rates are identified and are justified. Section 3.4.7.1 discusses dose conversion factors, and Table B-7 shows the ratio of dose factor differences between DOE and EPA dose factors for ingestion. In reality, the EPA dose factors should be used, since they are the more recent compilation and were intended for government-wide use (See Section 6.3.2.2). As shown in the text (page 3-49 *et seq.*), this does not make a significant difference in the results. While some dose factors (e.g., Tc-99) are somewhat higher, this does not affect the results of the dose calculations in a significant way, as demonstrated by Table B-7. Consequently, the analysis is complete, albeit not with the use of the most appropriate dose factors. The maximum dose was projected for 10,000 years, rather than 1000 years. This period of analysis was selected because of Nuclear Regulatory Commission licensing requirements for incidental waste as produced during high level waste activities. Consequently, the decision to examine a 10,000 year period rather than a 1000 year period after closure is acceptable.	No issues.
3.1.2.h. (continued) The dose analysis considers the exposure pathways and transfer factors and calculates the maximum dose using acceptable methodologies and parameters.	Yes	The methodologies and Parameters used are reasonable and are consistent with other Hanford performance assessments and are justified by the literature and site-specific investigations. It is noteworthy that, in the ILAW PA, the size of the garden has been reduced from 2,500 m^2 to 500 m^2. In the reviews of the earlier Hanford PAs, the larger garden size was controversial. The smaller size is reasonable and may be conservative.	Same as Section 3.1.2.h. issues.
3.1.2.h.1. The dose analysis for exposures to radionuclides identifies the transfer coefficients between media and justifies the parameters used in the analysis with supporting data or references to the literature	Yes	Same as Section 3.1.2.h response.	Same as Section 3.1.2.h. issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.h.2. The dose analysis specifies the consumption of radioactively contaminated materials for the exposure pathways evaluated, the inhalation rates of contaminated materials, and the external exposure rates and conditions to radioactive materials. These parameters are justified using references to the literature or site-specific investigations	Yes	Same as Section 3.1.2.h response.	Same as Section 3.1.2.h. issues.
3.1.2.h.3. The dose analysis is conducted using effective dose equivalents in accordance with ICRP-30 (1979) and uses dose conversion factors from recognized published sources.	Yes	Same as Section 3.1.2.h. response.	Same as Section 3.1.2.h. issues.
3.1.2.h.4. The maximum dose projected for 1000 years after facility closure at the point of compliance is used in the analysis for evaluating disposal of LLW or establishing waste acceptance criteria for future disposals	Yes	The PA used 10,000 years instead of 1,000 years for the time of compliance. This was justified on the basis of being necessary to obtain NRC concurrence in the incidental waste determination that will be required by DOE 435.1.	No issues.
3.1.2.i. The sensitivity and uncertainty analysis considers those parameters and mechanisms that are important to the conclusions relating to the long-term performance of the disposal facility, including radionuclide inventory, radionuclide characteristics, release rates, site and facility characteristics, groundwater flow parameters, site meteorology, and radionuclide transport parameters. Parametric and mechanistic variations analyzed in the uncertainty analysis that are important to the conclusions are justified as reasonable for the site and facility using data or related field investigations.	No	A deterministic base case was performed with a number of sensitivity analyses performed on a sub-system level (e.g., vadose-zone transport). However, the sensitivity analyses were occasionally performed with a different sub-system model (e.g., unit-cell model vs. disposal facility model). The lack of consistency raises concern over the results and conclusions of the sensitivity analyses. Additional sensitivity studies on hydrologic properties and strata types are needed. Specifically, the inclusion of heterogeneities in the vadose zone can lead to fast flow paths and should be considered in sensitivity analyses.	Lack of consistency between models used for the facility and sensitivity cases. Additional sensitivity analyses are needed to provide robustness to the analysis (e.g., vadose zone heterogeneities, poorer waste form performance).
3.1.2.i.1. The parameters important to the components of the analysis are analyzed to identify the sensitive parameters, and the selection of sensitive parameters is quantitatively justified	No	Same as Section 3.1.2.i response.	Same as Section 3.1.2.i. issues.
3.1.2.i.2. The sensitive parameters are analyzed for uncertainty in the results of the analysis to provide quantitative bounds for interpreting the results of the analysis.	No	Same as Section 3.1.2.i response.	Same as Section 3.1.2.i. issues.
3.1.2.i.3. The results of the sensitivity analysis are determined using a prescribed methodology that is technically justified. The results of the analysis provide the necessary information to justify the assumptions and conclusions of the performance assessment.	No	Same as Section 3.1.2.i response.	Same as Section 3.1.2.i. issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.i.4. The maximum projected dose and time of occurrence is presented in the performance assessment to provide for understanding of the natural system being modeled and the behavior of the model.	No	Same as Section 3.1.2.i. response.	Same as Section 3.1.2.i. issues.
3.1.2.j. The ALARA analysis provides a cost-benefit analysis that is an optimization of the collective or population dose based on the cost of dose reduction in the exposed population of $1,000 to $10,000 per person-rem averted. [ALARA analysis is not required if the projected individual or collective doses in the exposed population are trivial.]	No	Minimal ALARA discussion was presented. There is no explicit cost-benefit analysis relating to ALARA because conceptual facility designs were not available at the time of the report generation.	Minimal ALARA analysis.
3.1.2.k. The inadvertent intruder analysis considers the natural and man-made processes that impact the possible exposure to an intruder and calculates the dose using acceptable methodologies and parameters.	Yes	The inadvertent intruder analysis has considered reasonable natural and man-made processes that impact the possible exposure to an intruder. The dose resulting from the scenarios was calculated using acceptable methodologies and parameters. The analysis considers reduction in radionuclide concentration by mixing with soil in a garden. It is noteworthy that the ILAW PA used a more conservative value for the size of the garden than the value used in previous performance assessments (the value used in previous assessments was considered too large by some reviewers).	No issues.
3.1.2.k.1. The inadvertent intruder analysis specifies the reductions in concentrations of radioactive material from mixing with uncontaminated material or the transport of radionuclides from the disposed waste mass, and justifies the parameters used in the analysis with site data, supporting analysis or referenced information.	Yes	Same as Section 3.1.2.k response.	Same as Section 3.1.2.k issues.
3.1.2.k.2. The inadvertent intruder analysis accounts for naturally occurring processes (e.g., erosion, precipitation, flooding) and the degradation of engineered barriers in the calculation of results	Yes	Same as Section 3.1.2.k response.	Same as Section 3.1.2.k issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.2.k.3. The inadvertent intruder analysis calculates the maximum dose from disposed materials during the period of 100–1000 years after site closure for waste acceptance criteria for wastes to be disposed of in the disposal facility using the recommendations of ICRP-30 (1979) and dose conversion factors from recognized published sources.	Yes	The inadvertent intruder analysis has assumed that the Hanford barrier used to cover the closed disposal facility remains intact for 1,000 years. The PA assumed that the concrete vaults would be degraded at 500 years. These assumptions are considered reasonable. The inadvertent intruder analysis presented the dose calculated over the 1,000 year period of compliance. The dose calculation used dose conversion factors from recognized published sources that are consistent with ICRP-30. The maximum dose is used to assess disposal facility performance and establish waste acceptance criteria.	No issues.
3.1.2.l. The results of the analyses for transport of radionuclides and the inadvertent intrusion into the disposal facility, and the sensitivity and uncertainty of the calculated results are comprehensive representations of the existing knowledge of the site and the disposal facility design and operations.	Yes	Based on the caveat of existing knowledge of the site and since building criteria into the facility design and waste form requirements, the results are a reasonable representation. Specific facility design criteria have not been fully defined such as: cover design, including the hydraulic diverter; getter usage; filler material, therefore leaving flexibility within the design to compensate for waste form deviations if necessary. This is not explicitly stated though implied and leads to concern since decisions have not been made.	Not all facility design factors have been selected.. If design criteria are different than the scenarios completed, PA changes will have to be made.
3.1.3. PA Conclusions Are Valid and Acceptable			
3.1.3.a. The performance assessment presents valid conclusions that demonstrate that the all-pathways analysis, air pathway analysis, groundwater resource protection analysis, and inadvertent intruder analysis meet the performance objectives of DOE Order 5820.2A.	No	The performance assessment conclusions are not valid due to the incomplete information regarding waste form performance. See criterion 3.1.2.b.	Waste form performance not demonstrated. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.3.a.1. The all pathways performance objective of 25 mrem/year effective dose equivalent is met over the performance period of 1000 years for all radionuclides disposed of in the disposal facility.	No	Same as Section 3.1.3.a. response.	Same as Section 3.1.3.a. issues.
3.1.3.a.2. The air pathways performance objective of 10 mrem/year effective dose equivalent is met over the performance period of 1000 years for all radionuclides disposed of in the disposal facility.	Yes	The air pathways performance objective is met over the 10,000 year period justified for this analysis.	No issues.

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.3.a.3. The radon performance objective of an average flux of 20 pCi/m^2/s at the disposal surface or 0.5 pCi/L in air at the point of compliance is met over the performance period of 1000 years for all radionuclides disposed of in the disposal facility.	Yes	This measure is met by two entirely separate analytical approaches. First, there are insufficient radon precursors to generate significant radon. Second, the thick cover over the disposed waste reduces radon emissions by providing a thick cover that attenuates the diffusion of radon into the air. Consequently, the emissions of radon are trivial and the performance measure is met.	No issues
3.1.3.a.4. The groundwater resource performance measures for all radionuclides to be disposed of in the disposal facility are met over the performance period of 1000 years at the prescribed point of compliance.	No	The conclusion that the groundwater protection performance objective is met is not valid because no evidence that the assumed glass waste form performance is likely to be realized is provided.	Glass waste form performance was not demonstrated. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.3.a.5. The inadvertent intruder performance objectives of 100 mrem/year effective dose equivalent for chronic exposure and 500 mrem effective dose equivalent for acute exposure are met within the disposal facility over the performance period of 1000 years.	Yes	The inadvertent intruder performance objectives of 100 mrem/year for chronic exposure and 500 mrem for acute exposure are met for the period from about 200 years to 1,000 years and beyond. The results for the homesteader scenario exceed the 100 mrem/year performance objective at 100 years following closure. However, the assumption that inadvertent intrusion will be prohibited for 500 years following closure by passive means (markers, etc.) is reasonable.	No issues.
3.1.3.a.6. The condition that doses from the disposal of waste are ALARA has been demonstrated and incorporated into the design and operations of the disposal facility.	Yes	An adequate ALARA discussion has been presented based on the level of available detailed planning. No summary of ALARA considerations was presented; instead this considerations relied heavily on references.	Minimal ALARA analysis.
3.1.3.b. The performance assessment conclusions incorporate the findings of the calculated results for the all pathways analysis, air pathway analysis, groundwater resource protection analysis, inadvertent intruder analysis, and sensitivity and uncertainty analysis. The results are interpreted and integrated to formulate conclusions which are supported by the results and the uncertainties in the results.	No	The PA conclusions do not incorporate all results because the waste form performance is not demonstrated and therefore cannot be interpreted into facility design criteria. See discussion of 3.1.2.b. and 3.1.2.e.	Waste form performance not demonstrated. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).

Table C-2: Performance Assessment for Hanford Immobilized Low-Activity Tank Waste, 7/27/99			
Criteria	**Criteria met?**	**Response**	**Issues**
3.1.3.c. The conclusions of the performance assessment are applied to the facility design and operations. The resulting design constraints and limitations on operations can be reasonably accomplished at the disposal facility.	No	The results of the performance assessment have been interpreted to derive requirements on facility design, waste form and facility operations. These requirements were then examined in comparison with expected waste inventories, possible designs, etc. The conclusion is that the constraints can be readily met. However, the conclusion regarding waste form performance is not valid because no support for the assumed performance is provided.	No evidence provided that assumed waste form performance is achievable. Issue is being addressed by Hanford's additional research activities as noted in the supplemental information (see Appendix F).
3.1.3.d. The conclusions of the performance assessment address and incorporate any constraints included in any Federal, state, and local statutes or regulations or agreements that impact the site design, facility design, or facility operations. The conclusions also address and incorporate any procedural or site documentation changes or constraints due to the results of the facility performance assessment. Reasonable assurance exists that these constraints and impacts are appropriately addressed in the performance assessment.	No	This criterion is met with the exception of the constraint of long-term glass performance. No evidence is provided that the assumed performance can be achieved.	Same as Section 3.1.3.c. issues.
3.1.3.e. The analysis, results, and conclusions of the performance assessment provide both a reasonable representation of the disposal facility=s long-term performance and a reasonable expectation that the disposal facility will remain in compliance with DOE Order 5820.2A	No	This criterion is met with the exception of the constraint of long-term glass performance. No evidence is provided that the assumed performance can be achieved.	Same as Section 3.1.3.c. issues.

Harry Babad Comments on the
Composite Analysis for Hanford 200 Area Plateau and
Performance Assessment for Hanford Immobilized
Low-Activity Tank Waste

Potential **Compoite Analysis** Issues [2]:

- General Issue – I continue to be concerned by statements acknowledging conservatism in all areas of the Composite Analysis which do not even provide a best engineering judgement assessment of the degree of conservatism of those "assumed" factors. The propagation of conservatism by making use of source documents in which extensive conservatism existed and taming worse case data as the Composite Analysis input is also troubling.

I philosophically object to estimates and calculations that make the waste management environment managed by Department of Energy at Hanford appear worse then "it likely is." It does not matter that the projected "conservatively estimated" consequences are below regulatory guideline.
Examples include Kd values, treatment of uranium chain decay, maximal concentrations of radionuclides in ERDF, …

- General Issue – Assessment of the effects of past practices liquid discharges in the Composite Analysis conclusion should be given a high priority for the next Composite Analysis update. Specific examples of such concerns are noted below.

- Issue - Tank Retrieval losses due to sluicing that assumed to the buffer zone boundary appear at odds with assumptions in the Jacobs Engineering Retrieval report.

"DOE/RL 98-72; Retrieval Performance Evaluation Methodology for the AX Tank Farm, draft issued September 1998. (Jacobs Engineering Report).

Recommendation - Future Tank Inventory estimates for tank residuals and for tank retrieval losses should take into account Jacobs Engineering Retrieval report analyses in the next Composite Analysis update. Leaching estimates (source terms) which relies on nitrate concentration of unwashed sludge or saltcake samples typify unjustified conservatisms.

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Possible Issue: May be of technical concern and requires your assessment of importance to our recommendations.
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- Possible Issue - Estimates of Tank residual after sluicing that assume migration to the buffer zone boundary "during this century" appear at odds with the assumptions in the Jacobs Engineering report. Note sluicing would remove most if not all of the so called soluble species and barring a change in the tank environment to highly oxidizing, would not lead to the generation of more soluble species.

- Possible Issue - How does the fact that the tank related liquid discharge areas are considered to be CERCLA past practices units and will be remediated (in some TBD fashion) factored into the Composite Analysis? Considering the size and breadth of the contaminate area, a retrieve option appears unlikely. The solution is likely to be a barrier of some kind. The isotope of primary concern is 99-Technetium which was part of the "uranium process stream."

- Issue - Neglect of direct releases from canyon buildings, after possible "in plant" treatment such as a FeCN or strontium strikes, as purposeful effluent discharges (e.g., Material contained in Borsheim, G. L., and B. C. Simpson, 1991, An Assessment of the Inventories of the Ferrocyanide Watch List Tanks, WHC-SD-WM-ER-133, Rev. 0, Westinghouse Hanford Company, Richland, Washington. For ferrocyanide related treatment the approximate size of the waste stream sent to the tanks could support an back calculation of the volumes discharged which when coupled with process information provide an estimate inventory.

I have not been able to ascertain whether direct discharges to soil from canyon building occurred or whether after the "strike" the supernatent liquids were routes through some part of the tank farm system and would have been included with the190 MM Gallon release estimate in Appendix D of Groundwater/Vadose Zone Integration Project Specification, DOE/RL-98-48, Draft C, December 17, 1998.

The effects of cooling water, steam condensates volume appear to be factored into the ground water characteristics but the inventory associated with other more highly radioactive streams has not apparently been considered. It has not been demonstrated that the inventory from this material can be neglected in Composite Analysis.

Specifically, how does an estimate of such past facility discharges volumes and inventory compare to the 120 MM gallons purposely discharged from the Tanks farms by cascade?

- Possible Issue – Other excluded sites that may have a significant concern for the Composite Analysis conclusions and need to be addressed in the future include:
  - Unplanned release sites
  - Liquid Discharge Sites

- Possible Issue - Accidental releases from canyon cells to soils under the facilities, especially from the various acidic process streams that would corrode cell floor cement and leak into soils underneath. This could interact with existing plumes adding to their inventory.{Were the cells

in the reprocessing facilities lined with steel?} [See PA Section 3.2 for justification of neglecting them]

- Possible Issue - Purex Rail Road Tunnels as a source of 129-Iodine containing silver coated saddles. The assumption that remediation would leave a grout or gravel matrix cocoon in conjunction with a RCRA barrier that would prevent release of the radionuclide content has not been evaluated with respect to radio iodine.

- Issue - Burial Grounds containing "saddles" contaminated with 129-Iodine from the Purex scrubber. If these have been buried and indeed are leaded with 129-Iodine, the assumptions of migration from past practices burial grounds suggest that they would be a major source term that must be considered in the Composite Analysis.

- Possible Issue - Past Practices (pre-1980 burial grounds) including so called retrievable Transuranic disposal sites. It is not clear that these will indeed be retrieved, removing the source term, or covered with a protective barrier. In any case the migrational characteristics of transuranic in these burial sites, when admixed with organics and other waste has not been evaluated. They could constitute a significant transuranic source term.

- Possible Issue - Northward migration to the Columbia in the unconfined and the first confined aquifer near Gable Butte-Mountain "synclinal" structures.

- Concern - Data Quality Objectives process application to source inventories, waste site characteristics and also vadose zone and groundwater were compiled. How was this done? The usual Data Quality Objectives process identifies what information is needed and how well it is needed to define the parameter for sampling and analysis are needed to support specific decision making actions.

- Issue - Why should the solid waste burial grounds, if remediated by putting a RCRA or Hanford cover over them, release their inventory of RN over the first hundred years? Even without a cover, the nature of the buried materials makes efficient percolation and leaching of the RNs improbable Compared to the liquid discharge areas these are really unsaturated low-moisture sites containing, if I remember from the various Environmental Impact Statement assumptions, ca. A maximum of 5-10% moisture in their soils.

I can understand why putting a cover over the cribs and trenches, which were drenched with fluids and will have spread laterally beyond the "engineered structure," may not be a viable option. But the boundaries of the 200 Area burial grounds are well defined according to the Groundwater/Vadose Zone Integration Project Specification document (DOE/RL-98-48).

- Issue - Assumptions about high recharge rates, at solid waste disposal sites presently being operated, seem at odds with reality. The baseline calculations that provided little credit for the burial containers and were most of the migration took place prior to the placement of a cover over the suite seemed overly conservative. Although the report acknowledges that if credit for burial containers is taken extended the mean travel times for the radionuclides of concern.
- Possible Issue - Effect of continuously decreasing groundwater mounds under facilities does not seem to have been taken into account. Using conditions representing maximum hydrological drivers from these mounds seems overly conservative. These appear to be the drivers for the more rapid then expected tritium plume migration described in some migration assessments. It is not clear from the Composite Analysis when that driving force, as the mounds spread laterally while decreasing in height will provide a significant change the migrational aptitude in soluble species (e.g., their ground water travel time) over the 1000 year period evaluated.

- Comment: Isotopes selected for Composite Analysis consideration appear appropriate based on half-life, Kd and presence in Hanford waste (e.g., Tungsten to 187-rhenium).

- Possible Inventory Issue - Use of ORIGEN2 to estimate inventory (Carbon-14, Chlorine-99, Selenium-79, Technetium-99 and/or iodine-129) for undocumented radionuclides in SWITS and CERCLA liquid discharge sites is troublesome. For the most part, the amounts of these species in condensates from evaporators or other process condensate would leave most nonvolatile species behind. Only, depending on the conditions in the waste stream being evaporated, Carbon and possible iodine are volatile when stripped from acid media and these (e.g., carbon dioxide and elemental iodine) would not be efficiently condensed.

- Possible Cesium Inventory Issue – The relationship of the estimated cesium inventory and the amount of mobile cesium in tank that are know to contain a high silica content is usually not correct. In the presence of aluminum and silica in alkaline tank media, cesium cancrinite an insoluble mineral if formed, a form in which the cesium is not mobile. To the best of my knowledge, all aluminum clad fuels contained a bimetallic Al-Si compound as a “heat exchanger-transfer agent” between the fuel and the cladding.

In a similar fashion, the “Technetium Workshop Report” identified the fact that insoluble technetium can also exist in tanks, lower the source term with respect to migration of this species.

- Possible Sources - I believe there was, in addition to the Shippingport blanket (a form of spent fuel) stored in the head end of T-Plant in the 1970's, experimental spent fuel or spent fuel pieces stored either in the burial grounds or perhaps in silos on the 200 Area plateau. One of the tanks also contains some experimental fuels and Berilium shere (so I have been told) but that should not immediately affect the source term for the Composite Analysis. I have not been able to check on details from the WIDS data base but spent fuel odds and ends may be another item to consider relative to either the T-Plant facility source term, the older transuranic burial grounds source

terms or if my information is verified in silos containing small 1-5 metal cans of gallons of fuel or fuel fragments.

Last but not Least – The presence and role in transport of complexing has been significantly overstated. Discussions documented in Meacham '98 indicate that complexing species such as EDTA. HEDTA and citrate have been destroyed by a combination of radiolysis and thermolysis in the tank environment, leading to residual organic species with little or no complexing power. Thus the retardation caused by low Kds associated with such species are likely overestimated.

Meacham, J. E., W. L. Cowley, A. B. Web, N. W. Kirch,. J. A. Lecht, D. A. Reynolds, L. A. Stauffer, D. B. Bechtold, D. M. Camaioni, F. Gao, R. T. Hallen, P. G. Heasler, J. L. Huckaby, R. D. Scheele, C. S. Simmons, J. J. Toth, and L. M. Stock; Organic Complexant Topical Report, HNF-SD-WM-CN-058, Rev. 2, Fluor Daniel Hanford Co., 1998.

- Issue – The Composite Analysis (as well as the Performance Assessment) significantly over estimates tank inventory of technetium as described in TWRS Technetium Workshop {Results}, WIT-97-027, Prepared for Department of Energy-Richland Operations by the Independent Review Team, October, 1998, Richland, WA. [Authors: Moses Attrep, jr., Harry Babad, Vincent Van Brunt, J. Louis Kovach, William Kuhn, and George G. Wicks.]

- Possible Issues with Critical Isotope Kds - Kds associated with complexants may underestimate retardation since the presence in a significant number of high TOC/technetium tanks of Tc (IV) and Tc(V) species that are soluble as reported in the Technetium Workshop Report] suggests that such species could react with soil constituents and precipitate out as the oxy-hydroxide, resulting in reduced transport.

Recommendation - Future Tank Kd estimates for Technetium in leaked waste, residuals and for tank retrieval losses should take into account tank speciation information as part of near field vadose zone studies.

In general, getting near field and far Kd values for key radionuclides that have been given zero Kd values in the vadose zone should be given priority prior to the next Composite Analysis revision. Changes in the vadose zone environment, include a potential for not only changes in pH (e.g., neutralization by soil constituents) but also redox other chemical changes.

POTENTIAL PERFORMANCE ASSESSMENT ISSUES [3]**:**

- **Conclusion** - There are no shop stoppers associated with this Immobilized Low-Activity Tank Waste Performance Assessment document. I do have a significant number of chemistry related concerns that should be addressed in the next Performance Assessment update. I would like to see them become a part of our team recommendation.

- **General Issue** – I continue to be concerned by statements acknowledging conservatism in all areas of the Performance Assessment which does not provide a SUMMARY best engineering judgement assessment of the degree of conservatism of those combined "assumed" factors. Although Mann et al are explicit in the detailing of such "conservatisms", nowhere do they estimate the cumulative effects of these COMBINED conservative assumptions on the Performance Assessment results. Propagation of conservatisms by making use of individual input data in which initially conservative estimates were documented and then combing as bounding ["worse"] case model input as the Performance Assessment input continue to be troubling.

I continue to philosophically object to estimates and calculations that make the waste management environment managed by Department of Energy at Hanford appear more risky then "it likely is." It does not matter, whether under the calculated circumstances, that the projected "conservatively estimated" consequences are below regulatory guideline.

- **General Conclusions on Waste Form Characteristics (Source Term)** – Although the assumptions on glass corrosion reflected the selected waste glass composition as defined by BNFL they provide a reasonable basis for release terms in the Performance Assessment. They also did not reflected recent findings in Reference 3, PNNL-12014 (B. P. McGrail September 1998). It is likely that the applied glass composition studies being funded at SRTC by BNFL and other previously reported in the literature, and evaluated by the methods recommended in McGrail et al October 1998 will create a high sodium glass waste Immobilized Low-Activity Tank Waste form updates.

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Possible Issue: May be of technical concern and requires your assessment of importance to our recommendations.
Concern: Items that troubled me but did not affect the technical acceptability of the Composite Analysis or Performance Assessment.

Recommendation – The work defined in the McGrail et al strategy document should be performed with best available glass composition as obtained from BNFL. Specifically, specifications for waste glass in either future updates of the Performance Assessment or as needed in future contract revisions (DOE-RL and BNFL) should be based on both modeled system performance estimates (e. g., Performance Assessment type analysis) and waste form testing to assure that models as well as data closely approximate the real waste system being designed by BNFL. This is the strategy espoused in the present Performance Assessment and should be generally supported by Department of Energy.

- **Possible Cesium Inventory Issue** – The relationship of the estimated cesium inventory and the amount of cesium in tanks that are know to contain a high silica content is usually not correct. In the presence of aluminum and silica in alkaline tank media, cesium cancrinite an insoluble mineral if formed, a form in which the cesium is not mobile. To the best of my knowledge, all aluminum clad fuels contained a bimetallic Al-Si compound as a "heat exchanger-transfer agent" between the fuel and the cladding.

In addition the contractual requirements for cesium removal by BNFL need to be updated, as inputs to planned Performance Assessment revisions, as they evolve. However the soluble cesium content in existing waste may be significantly lower then that projected by present estimates in high aluminum containing tanks.

In a similar fashion, the "Technetium Workshop Report" identified the fact that insoluble technetium can also exist in tanks, lower the source term with respect to less inventory and subsequent migration of this species.

- **Specific Technetium inventory Issues** – The Performance Assessment significantly over estimates tank inventory of technetium, as well as technetium chemistry both in tanks and in glass as described in TWRS Technetium Workshop {Results Document}, WIT-97-027, Prepared for Department of Energy-Richland Operations by the Independent Review Team, October, 1998, Richland, WA. [Authors: Moses Attrep, jr., Harry Babad, Vincent Van Brunt, J. Louis Kovach, William Kuhn, and George G. Wicks.]

  Specifically:

  - Shortfalls in the PHMC and Agnew solubility model that do not take the presence of significant amounts of Tc (IV) and Tc (V) in Hanford waste into account.

  - Insufficient assessment of the amount of Tc shipped off site with Uranium to Fernald or elsewhere. At Savannah River Site, most of the technetium inventory was considered removed from the tanks along with the "exported" uranium separated in their Purex process.

- The use of "conservative" technetium splits estimates [e.g., in-tank and out of tank partioning] in which the error bands utilized exceed a bounding +/- 10% inventory errors associated with the ORIGEN2 codes for generation of that nuclide. Such conservatisms are scientifically unjustified.

- Serious analytical shortfalls that appear to over estimate technetium concentration as a result of problems with the primary assay methods used to historically measure technetium in Hanford waste tanks.

- Significant (ca. 50%) TcO_2 volatility occurs when pertechnetate is added to the glass melter. That material would collect in the off gas system not the Immobilized Low-Activity Tank Waste according to Ian L. Pegg's work at the Catholic University of America in their Vitreous State Laboratory in ca. 1997-8.

  Also recent work at Argonne National Laboratories by Bill Ebert has demonstrated that TcO_2 disproportionates in the glasses tested to Tc_2O_7 (which is very volatile) and technetium metal which may phase separate. However, Ebert found that sodium pertechnetate does dissolve in glass if it is not concerted to sodium oxide and Tc_2O_7 under melter cold cap conditions. This suggest that knowledge of the oxidation state and species in the melter feed is a critical characteristic, one which was not addressed in this Performance Assessment.

- An apparently indefensible estimate of the amounts of technetium routed to cribs either from in-plant cesium removal or in tank cesium removal followed by release of the supernatant fluids to ground. The estimate of technetium lost to tank leaks is also somewhat speculative. These may be low by about 100% of their reported values, reducing the amount of technetium available to the Immobilized Low-Activity Tank Waste form.

- **Possible Issues with Critical Isotope Kds** - The Kds (and species solubility) associated with glass release may underestimate retardation since the presence of secondary minerals formed by glass corrosions (e.g., Phillipsite) resulting in reduced transport. Various investigators have ground greater then 80% of the technetium in glass is bound up in secondary alteration products. In addition, based on PUF/UFA by tests McGrail et al., the characteristics of the corroded materials appears to reduce the ability of the radionuclides to migrate away from the corrosion zone.

Recommendation – Both formation of insoluble technetium containing secondary minerals and reduced transport resulting from lower density more tightly packed corrosion products need to be considered in future Performance Assessment updates.

- **Possible Release-Migration Issues**

  - The values for Kds in the near field of the vadose zone for the Performance Assessment and the Composite Analysis appear to differ. Should we, the Composite Analysis/Performance

Assessment review team, recommend a creation of a "universal" set of Kds that reflect waste and waste form chemistry to be used in all future assessment-analysis documents? These can be modified as experimental data on waste specific-soil type specific sorption coefficients being sought by the site matures. "Paleo"-soils are an example of soil types that seem not to have been explored but may have high capacity to interact with migrating radionuclides.

- The assumption that the glass release, after an estimated time of waste package degradation (no explicit credit for the container taken) is linear (4.4×10^{-6} of current inventory) despite [a] the formation of a larger volume of corrosion products and [b] the fact that packages lower in the "stack" are protected from vertical moisture migration appears to be too conservative and should be replaced in future Performance Assessments by a combination of experimental data and some correction for the position of the glass block in the vault.

• **MORE SPECIFIC CHEMICAL ISSUES**

129-Iodine. It was not clear to me from reading the Performance Assessment how the following two conditions were considered in Performance Assessment:

- The fact that data appears to make a case that iodine is either no longer in the tanks (based on only a little characterization data). Apparently much of the iodine released in reprocessing was either vented up the individual plant stacks or collected on silver-coated saddles and buried.

- Iodine will not be incorporated into glass but rather will be collected in the off gas scrubber in the glass plant (See Shelton 1995 as referenced in the Performance Assessment).

- In light of present knowledge, the assumption that 10% of the iodine inventory goes to Immobilized Low-Activity Tank Waste continues to be troublesome.

Carbon-14.

- In alkaline medium most carbonate salts are insoluble and would not get to the LAW fraction.

- Also the fact the carbon-14 as carbonate in the feed would volatilize under melter conditions as 14-carbon dioxide was not clearly discussed.

High Iron Waste Package Environment.

- How is the fact that the near field environment around the corroding glass is a high iron environment, one which can significantly effect waste form or released waste redox properties being treated? This factor appears to have been defacto ignored in this draft of the Performance Assessment

– It is not clear (from Pete McGrail's presentations) why there is a concern about iron in the Immobilized Low-Activity Tank Waste melter. I was under the impression that iron in Hanford waste is insoluble and would preferentially be sent to the HLW fraction.

[More on iron in the waste package environment can be found below.]

Waste Partioning of Tin. – There is no referenced credible basis to assume that all the tin in Hanford waste tanks will partition to the Immobilized Low-Activity Tank Waste. Solubility information for the various tin species should be applied for this radionuclide for the next Performance Assessment revision.

- **Possible Recommendation: Potential Use of FeS Getter** – Savannah River has demonstrated, as have other literature references, the relatively irreversible reduction of pertechnetate to technetium sulfide by the iron sulfide in the power plant ash based slag used in their grout formulation. Using such material in either vaults or admixed with the fill within the vault could appreciably reduce migration of technetium and other "oxidized species. I believe this deserves a trade-off study as part of the data used in the next update of the Performance Assessment. Doing so would minimize the long term uncertainties associated with Tc migration over the 10,000 years of concern.

- **Possible Issue On Key Radionuclides of Concern** – If indeed Technetium become a non-issue in Immobilized Low-Activity Tank Waste for reasons cited both in the Technetium Workshop document and in my previous comments, DOE needs to take a closer look at 126-Tin and 79-Selenium as radionuclides of concern, along with the uranium isotopes already being considered.

- **Recommendation on the Performance Assessment and Contractual Changes** - The Performance Assessment should continue to follow and take cognizance of, changes in the contract between DOE and BNFL as the Performance Assessment is updated, particularly those associated with either the pretreatment requirements or glass product specifications. Furthermore, as stated in the Performance Assessment, as the disposal system design evolves, these too should be factored in future Performance Assessment revisions. As the Performance Assessment staff is well aware, the current contract between BNFL and DOE no longer assumes in-tank sludge washing or alkali leaching by the PHMC. Such activities are part of the pretreatment steps that may be included by the privatization contractor in order to meet DOE performance specifications.

- **Possible Issue Unconfined Aquifer Travel Time** - I am not sure how much excess conservatism is implied by the fact that "because radionuclides spend significantly less time in the unconfined aquifer then in the vadose zone, no credit for increased travel time in the unconfined aquifer because of geochemical retardation was taken." [Performance Assessment Page 3-32] My major concern, is that I have not read anything that explicitly proves that the redox state in the aquifer is oxidizing [e.g., high (Fe (III)/Fe (II) ratios]. That would be required

before one can conclude that the environment along the travel path would indeed not reduce multivalent radionuclides along this pathway.

- **The Role of Iron in the Waste Disposal Environment** – Assuming that the container containing the Immobilized Low-Activity Tank Waste glass must meet transportation specifications, there will be a lot of iron in the filled waste packages in the vault. The effect of this reducing agent on properties of the water infiltrating into the vault, and on the release of radionuclide needs to be carefully determined. It is just as likely that the vault environment (for as long as appreciable iron remains unoxidized), will be reducing and possibly anoxic as the assumptions [oxic oxidizing environment] defined in the Performance Assessment.

Furthermore is basalt rip-rap or other fresh crushed basalt is used in closing the low-level repository, it too will contribute a reducing environment.

References Reviewed and/or Cited:

[1] Mann, F. M., R. J. Puigh II, P. D. Rittmann (FDH), A. H. Lu, G. F. Williamson (WHC), N. W. Kline (LMS), J. A. Voogd (LMHC), Y. Chen, C. R. Eiholzer, C. T. Kincaid, B. P. McGrail (PNNL), N. R. Brown and P. E. LaMont (DOE-RL); Hanford Immobilized Low-Activity Tank Waste Performance Assessment, DOE-RL-97-69, United States Department of Energy, Richland, WA.

[2] McGrail, B. P., W. L. Ebert, D. H. Bacon and D. M. Strachan; A Strategy to Conduct an Analysis of the Long-Term Performance of Low-Activity Waste Glass in a Shallow Subsurface Disposal System at Hanford, PNNL-11834, October 1998, Pacific Northwest National Laboratory, Richland, WA. [Also found as Appendix G in the Performance Assessment document.]

[3] McGrail, B. P. P. F. Martin, C. W. Lindenmeier. and H. T. Schaef; Corrosion Testing of Low Activity Waste Glasses, PNNL-12014, September 1998, Pacific Northwest National Laboratory, Richland, WA.

[4] TWRS Technetium Workshop {Results}, WIT-97-027, Prepared for Department of Energy-Richland Operations by the Independent Review Team, October, 1998, Richland, WA. [Authors: Moses Attrep, jr., Harry Babad, Vincent Van Brunt, J. Louis Kovach, William Kuhn, and George G. Wicks.]

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